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Lime/Limestone Scrubbing Sludge Characterization Shawnee Test Facility

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LIME/LIMESTONE SCRUBBING SLUDGE CHARACTERIZATION -- SHAWNEE TEST FACILITY

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LIME/LIMESTONE SCRUBBING SLUDGE CHARACTERIZATION -- SHAWNEE TEST FACILITY

by

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ABSTRACT

This report summarizes the work completed during the period March 13, 1975, to June 31, 1976, whose main emphasis has been to determine the range of variability of the solids from scrubbers operated at the Shawnee Test Facility and to attempt to correlate this variability with plant operating conditions. Slurry and solids characterization studies have been conducted on 84 samples received from the TCA and Venturi-spray tower scrubbing systems.

Solids samples obtained from the TCA and Venturi-spray tower scrubbing process loops generally consist of calcium sulfite hemihydrate and fly ash with trace quantities of gypsum, unreacted absorbent, and quartz. The calcium sulfite hemihydrate species is generally the major component (50-70%) of the solids.

The specific form in which the sulfite species appears was found to be directly related to the type of absorbent used (lime or limestone) and to be independent of the scrubber configuration (TCA or Venturi-spray tower). When limestone is used as the absorbent, the sulfite crystallizes predominantly as well-formed single plates; while on the other hand, when lime is used as the absorbent, the sulfite appears as spherical, closely interpenetrating aggregates. The average size of the sulfite plates formed from the limestone system appears to be inversely related to the system stoichiometry. No relationship has been seen in the lime system.

Besides the sulfite, fly ash is the most important of the accessory components in sludge samples, comprising 20-40 percent by weight of the solids composition. The fly ash spheres may be solid or hollow and consist of an amorphous aluminosilicate material sometimes containing calcium and/or iron.

The sedimentation behavior of the sludge slurries may be described generally by three basic modes: clarification, zone settling, and compression settling. Solids morphology was found to exert a strong influence on settling behavior. In samples with large proportions of very small plates or complex crystalline forms, settling is inhibited because more liquor is entrapped upon reaching the compression stage.

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SECTION 1

INTRODUCTION

In the past, sludges produced by flue gas desulfurization processes have been extensively characterized, both physically and chemically, but usually this type of effort has only been of limited scope, not defining the total range of variability of the solids or relating any of the characteristics back to the scrubber operation. With the increasing use of sludge treatment processes requiring relatively consistent sludge characteristics, this lack of research in solid characterization presents problems in designing such systems, especially since the chemical and physical makeup directly impacts the disposal requirements.

Thus, the main purpose of this study has been to determine the range of variability of the solids produced from scrubbers operated at the Shawnee test facility and to attempt to correlate this variability with plant operating conditions. The plant operating conditions that have been evaluated in this study include the liquid/gas ratio, presence of fly ash, hold tank residence time, percent solid oxidation, calcium to sulfur stoichiometry, and the process slurry pH, temperature, and percent solids.

These initial studies, both qualitative and quantitative, have used comparative optical, X-ray, infrared, and scanning electron micrographic investigations of the sludges from the Shawnee scrubbers and provide a good base for describing the range of variability observed in sludge phases. Settling rates and bulk densities provide data on the physical properties of sludges

This report presents data collected from samples acquired between March 13, 1975, to June 31, 1976. (Refer to Table IV, Schedule of Shawnee test runs.) The various types of data obtained from these samples have been evaluated to determine the effects of significant variables on the properties of the solids produced.

SECTION 2

CONCLUSIONS AND RECOMMENDATIONS

At this point in the project, the data collection is incomplete and in many cases no firm conclusions can be drawn between data trends and process variables. In some cases, definite relationships have emerged, but these are still subject to further refinement or modification upon completion of the sampling program.

The type of absorbent used (lime or limestone) has a direct effect on the specific form of the sulfite species. The form of the sulfite species is independent of the scrubber configuration (TCA or Venturi-spray tower). An absorbent of lime causes the sulfite to appear as spherical, closely interpenetrating aggregates. When an absorbent of limestone is used, the sulfite crystallizes predominantly as well-formed single plates. The average size of the sulfite plates appears to be inversely related to the stoichiometry of the system. No relationship has been found in the lime system.

An important factor that needs further evaluation is the response time of the solids for showing change in characteristics. This plays a decisive role in characterization of the solids since they are a function of liquor chemistry and scrubber operation averaged over a preceding period of time as opposed to one specific increment of time. The time required for the solids as a mass to adjust to a specific change and establish a new equilibrium in terms of chemical composition or morphology can range from one to three days. Because of this, time correlations will be meaningful only if composition or morphology factors are representative of some prior finite period of operation.

SECTION 3

INSTRUMENTAL TECHNIQUES OF CHARACTERIZATION

During the period March 13, 1975, to June 31, 1976, slurry and solids characterization studies have been conducted using 84 samples received from the TCA and Venturi-spray tower scrubbing systems located at the Shawnee Test Facility. A number of different instrumental techniques have been employed in this characterization. Scanning electron microscopy and optical microscopy have provided both qualitative and quantitative information concerning bulk solids composition, as well as the specific morphological from in which various individual components occur. Infrared spectrophotometry and X-ray powder diffraction measurements have been used for semi-quantitative analyses of the dried solids, and their specific surface area was determined as an indication of solids component morphology. Since a portion of this study involves investigation of the degree to which the calcium sulfite hemihydrate component may have been substituted by sulfate or carbonate species, several techniques have been used to reflect any changes in crystal structure caused by this substitution. Optical microscopy was used to provide the index of refraction of this component, while its specific unit cell parameters which are sensitive to compositional changes were obtained from X-ray powder diffractometry. In addition, differential scanning calorimetry is being evaluated as an indicator of the ease with which the sulfite component will undergo dehydration, since the temperature of dehydration should, in general, vary inversely with the degree of substitution of sulfate for sulfite.

Slurries obtained from the scrubbing systems were characterized by static settling tests; values for the settled bulk densities and settled percent solids also were determined.

The results of the chemical and physical examination of the slurries and solids are summarized in Tables I and II. A discussion of specific areas of investigation follows.

SECTION 4

SOLIDS MORPHOLOGY

Solids samples obtained from the TCA and Venturi spray tower scrubbing process loops generally consist of calcium sulfite hemihydrate and fly ash with trace quantities of gypsum, unreacted absorbent, and quartz.

Sulfite Morphology

The calcium sulfite hemihydrate species was generally the major component (50-70%) of the solids; therefore, a study of its morphology and occurrence is important as these factors bear heavily on applied considerations such as sludge filtration, clarification, and disposal. The crystalline species referred to as calcium sulfite hemihydrate may be more appropriately described as $\text{Ca}(\text{SO}_3) \times (\text{SO}_4)_y \cdot z\text{H}_2\text{O}$ or $(\text{CaSO}_3) \times (\text{CaSO}_4)_y \cdot z\text{H}_2\text{O}$ where x is much greater than y, and z approaches 0.5.

The specific physical form in which the sulfite species appears is directly related to the type of absorbent used (lime or limestone) and is independent of the scrubber configuration (TCA or Venturi-spray tower). The calcium sulfite hemihydrate component of the solids samples received during this period occurs in several forms as seen in Figure 1. When limestone is used as the absorbent, the sulfite crystallizes predominantly as well-formed single plates with a length-width-thickness average ratio of approximately 25:20:1 (Figures 1A and 1B). While within a given sample the crystallite size distribution will range over an order of magnitude, the average size may differ only by a factor of two to three from one sample to another within the same run. The sulfite crystals in Figure 1A and 1B show the general maximum and minimum sizes observed in limestone scrubbing systems. While the flat plates described above are the major form observed, aggregated forms of the sulfite crystals are also seen. An example of a form appropriately described as a flat or two dimensional "rosette" in which many small plates grow outward in all directions, particularly at low angles, around an axis perpendicular to the plane of growth is shown in Figure 1C. This form is not uncommon. Most samples examined from limestone scrubbing operation will contain some incidence of this rosette form, and a few samples have shown this form as the predominant sulfite occurrence. A more open form of aggregate resulting from the use of limestone is shown in Figure 1D. These forms consist of interpenetrating plates forming relatively open structures of varying sizes and shapes. Their occurrence in small amounts is a common feature.

The characteristic form of the sulfite precipitated from scrubbing liquors where lime is used as the absorbent is shown in Figures 1E and 1F. These generally spherical, closely interpenetrating aggregates are found almost to the total exclusion of other forms. Unlike the flat plates occurring during limestone scrubbing, the spherical aggregates do not show a wide variation in size distribution within a given sample, although incompletely developed forms and fragments are often seen.

To clearly demonstrate that the sulfite habit is scrubber-independent and absorbent-dependent, the samples obtained from the Venturi-spray tower scrubber over the period March 13, 1975, to June 27, 1976 may be subdivided into five separate groups:

- (a) 3-13-75 to 10-5-76, lime scrubbing, Figure 2
- (b) 10-12-75 to 1-31-76, limestone scrubbing, Figure 3
- (c) 2-15-76 to 3-2-76, lime scrubbing, Figure 4
- (d) 3-6-76 to 4-21-76, limestone scrubbing, Figure 5
- (e) 5-1-76 to 6-27-76, lime scrubbing, Figure 6

During this period the use of limestone as the absorbent was alternated with that of lime as shown. The results repeatedly show the spherical sulfite aggregate occurrence (Figures 2, 4, 6) when lime is used. When limestone is used, however, flat plates are seen to predominate (Figures 3,5). While this morphology-absorbent relationship is clearly established, no explanation for this effect is offered at this time.

Special attention may be given to Figure 6F in which the aggregates are seen to consist of much smaller, more densely interpenetrating plates than previously observed. Although the exact cause of this differentiation has not been determined, it should be noted that the level of the chloride ion in the scrubbing liquor is much higher for the time at which this sample was taken (2.13%) than for any other sample studied in this system.

In lime systems, no definite relationship has yet been found between aggregate size and either chemical composition or physical operating parameters. When limestone is used as the absorbent, however, the average size of the plate crystals formed in this environment appears to be inversely related to system stoichiometry, as shown in Figures 7A-F. The micrographs show a steadily decreasing average crystallite size with increasing Ca:S stoichiometry. While no precise mathematical relationship between crystal size and stoichiometry has yet been derived, this observation nevertheless argues in favor of stoichiometries approaching 1.0 in order to promote faster slurry filtration and clarification.

For both lime and limestone systems, average crystallite or aggregate size has been compared to slurry pH, hold tank residence time, make/pass, L/G, and slurry temperature. No defined relationship has been observed between any of these parameters and the size of either crystals or aggregates.

During the course of examination of samples received, a previously unreported form of "mixed crystal" was observed occurring during the period January 1, 1976, to January 10, 1976, in both the TCA and Venturi-spray tower systems and is shown in Figures 8 and 9. The usual appearance is that shown in Figures 8A, 8C, 9A, and 9B where a sulfite rosette appears in intimate physical association with a well developed, although often imperfect, gypsum crystal. The gypsum crystals often show a large number of surface cracks and longitudinal crystal defects. Enlarged views of the areas of contact between the two forms show what appear to be $\text{CaSO}_3 \cdot 0.5\text{H}_2\text{O}$ plate crystals growing from the body of the gypsum prism. Figure 8E is such an enlargement of a contact zone of the crystal shown in 8A; note also the arrows in Figures 8D, 9C, 9D. Occurrence of these "mixed crystals" has not been routinely observed in samples other than those included in the time period quoted above, and in these samples only in minor quantities (less than 5 percent). These forms may be related to the gypsum-calcium sulfite hemihydrate solid solutions referred to by Borgwardt. Comparison of sample chemical composition and scrubber operating data for the period of time during which these samples were taken indicates no excursions from normal values which might be helpful in explaining the sudden appearance of these mixed forms. No explanation for their presence is offered at this time.

Morphology of Accessory Components

Fly ash is the most important of the accessory components in sludge samples examined to date, comprising 20-40 percent by weight of the solids composition. It is normally present in the form of featureless spheres ranging in diameter from submicron sizes up to those greater than 100 microns. The spheres may be solid or hollow and consist of an amorphous aluminosilicate material sometimes containing calcium and/or iron. A portion of the fly ash is magnetic and ranges in quantity from 5-60 percent by weight. A small fraction of the fly ash constituent is not spherical but appears as irregularly shaped, vesicular particles. Rarely, $\text{CaSO}_3 \cdot 0.5\text{H}_2\text{O}$ flat plates will be observed to have been precipitated on the surface of a fly ash sphere.

Gypsum and unreacted absorbent are generally observed in very small quantities (less than 5 percent total). The $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ occurs primarily as broken and partially decomposed prisms (left center, Figure 3C) or as twinned forms (Figure 5B). Unreacted absorbent will be seen as partially or almost completely dissolved irregular forms (right center, Figure 5A, and bottom center, Figure 7B).

SECTION 5

SLURRY SETTLING BEHAVIOR

The settling behavior of slurries received during this reporting period has been determined by a static method. The samples (approximately 1 liter in volume) are transferred to 1 liter graduated cylinders (with an inside diameter of 6 cm and with a depth of 42 cm), mixed thoroughly by stirring and repeated inversion of the cylinders, and then allowed to settle. The height of the solids-liquid interface is tabulated and plotted as a function of time.

The sedimentation behavior of particulate (non-flocculant) slurries may be described generally by three basic modes: clarification, zone settling, and compression with clarification applying at low solids concentration and compression applying at very high percents of solids. In the clarification mode, individual particles settle independently at constant rates which are primarily dependent on particle size and shape (Stokes Law applies). Considerable particle size differentiation occurs with the larger particles settling first and the smallest last. In the zone settling mode, because of the higher percent of solids, the particles are conceived to be locked into a plastic structure with very little independent settling. Here, the solids subside as a consolidated structure so that ideally a single settling rate may be ascribed to all particles; this settling rate will be a function of solids concentration. Ultimately, with very high solids percent or towards the end of any static settling test, the regime of compression settling will be reached. In this mode, the hydrostatic bearing capacity of the settled solids, including entrapped liquor, is assumed to be approximately equal to the load produced by the settled solids plus any overlying liquid. Under these conditions subsequent subsidence will occur primarily through the formation of dewatering channels or the rake action at the bottom of the clarifier.

Under the conditions in our tests (limiting cylinder diameter, static settling, 12-25 percent solids in slurry), zone settling applies in that there is very little particle size or shape differentiation during settling, i.e., the entire body of solids settles simultaneously by dewatering. There is very little free particle settling. Rather, all particles settle together, their combined weight gradually forcing the water contained within the slurry past them to the top of the interface. As the settling slurry approaches compression "dewatering

channels" may be seen in cross section through the glass cylinder walls. These channels give the appearance of dendritic or tree-like structures arising from many small channels at a depth of 7-8 centimeters beneath the interface and gradually coalescing into a single channel which allows the water to escape from the settling solids.

Settling rates and behavior for samples of similar particulate composition are generally dependent on slurry percent solids with the thicker slurries settling more slowly. This may be illustrated through reference to Figure 10A, in which the settling rates for some limestone slurries are shown by a plot of interface position as a function of time. Individual curves are labeled for sample identification and original slurry percent solids. It is observed that thicker (higher percent solids) slurries have lower settling rates and take longer to reach the compression stage.

No precise relationship between slurry percent of solids and slurry settling rates may be expressed because sample solids morphology also exerts a strong influence. As an example of this effect, we may compare the behavior of slurries obtained from the TCA system on May 14, 1976 and April 12, 1976 (Figure 10B). Although the weight percent of solids in both slurries is essentially the same, the sample taken on April 12, 1976, settles more than three times as fast and attains, when settled to compaction, an ultimate solids weight percent of 68 percent as compared to 38 percent for that sample taken on May 14, 1976. Inspection of the micrographs of these solids (Figure 11) reveals that while both contain a predominance of single plates, the sample taken on May 14, 1976, consists of a large proportion of very small plates and plate fragments. These smaller particles inhibit settling and entrap more liquor upon reaching the compression stage due to a much higher incidence of interparticle touching. This limits the amount of liquor that may flow past them during settling and increases the difficulty with which dewatering can occur.

Due to sample handling and shipping, the static settling tests performed at Muscle Shoals are conducted from 3 to 10 days after the samples are originally taken from the process loop. Settling tests conducted at the Shawnee Test Facility, however, are generally performed within a short time after acquisition. In addition, settling data at Shawnee are generated by the Dorr-Oliver method which differs from a static test because the bottom of the test cylinder contains a rake rotated at 1/6 rpm during the settling test. In order to compare data generated by the two methods and to evaluate any effects caused by the delay in testing, a program of comparison tests has been conducted. The results of this work are contained in Table III. Based upon this information, it may be concluded that no significant, systematic difference is seen between the two procedures given the range of sample percent of solids studied and within the context of the types of slurry samples included in the tests.

SECTION 6

SOLIDS SURFACE AREA MEASUREMENTS

The size, shape, and complexity of individual solid particles in the scrubbing slurry are important because these factors may influence or control processes such as chemical reaction speed and filtration or dewatering rates. A direct indication of the average particle size and complexity of the slurry solids is available in measurements of the solids surface area. The equipment and methodology necessary to perform this measurement has been developed in the laboratory and implemented for routine characterization of dried scrubber solids. The specific technique used is a nitrogen desorption method based on a variation of the single point B.E.T. Method and is adequately described by Crob.²

Values in square meters/gram for the surface area of samples received during this period are reported in Tables I and II; areas determined range from 1.6 to 7.6 square meters/gram. The average specific area for samples obtained during lime scrubbing is greater than that measured for samples taken from systems employing limestone (for lime, 5.4 ± 1.3 compared to 3.3 ± 1.0 for limestone). The sludge which results from lime scrubbing is more difficult to dewater than sludge from limestone scrubbing. This data agrees with the observation that lime scrubbing tends to precipitate the sulfite crystals as more complex, interpenetrating forms. The tabulated values of specific surface area are not readily correlated with variations in sulfite crystal size or complexity, even though this component may comprise (by weight percent) the majority of the sample, due to masking effects caused by the wide variation in quantity and particle size distribution of the fly ash fraction. Work in progress is intended to explore possible relationships between the specific area of a sample and its filterability. In addition, the series of "fly ash-free" runs begun on the Venturi-spray tower system in June 1976 should provide samples displaying less of the fly ash masking effect referred to above and thus simplify further correlational studies.

SECTION 7

THERMAL ANALYSIS OF SCRUBBER SOLIDS

Thermal analysis of the dried scrubbing solids has been employed using differential scanning calorimetry (DSC) in the range 330-500 degrees centigrade. This temperature range was selected in order to study the thermal dehydration of the $\text{CaSO}_3 \cdot 0.5\text{H}_2\text{O}$ component. It is felt that substitution of carbonate of sulfate into the sulfite structure will result in either a shift of this compound's desolvation temperature away from that deserved in the pure compound or in an increase in complexity of the normally straightforward endothermic desolvation reaction. All samples received since March 20, 1976, have been analyzed using a Perkin-Elmer DSC-2 differential scanning calorimeter. The temperature scan rate used was $10^\circ\text{C}/\text{min}$ and dry nitrogen at a rate of 20 cc/min was used as the purge gas. Prior thermal history consisted of preheating the samples in the instrument at a temperature of 330°C for a period of 15 minutes. All samples were analyzed in nonvolatile sample pans (small aluminum containers approximately 0.25 inches in diameter and 0.125 inches in depth with aluminum cover discs lightly crimped in place to prevent sample loss, but not hermetically sealed).

Two types of thermal activity have been observed. The type of behavior illustrated in Figure 12A has been observed to predominate in samples taken from lime systems. Here a generally straightforward endothermic desolvation of the sulfite occurs only after an initial reaction which may represent a gradual desolvation or decomposition of an unknown compound.

Figure 12B shows a type of thermal activity which is representative of limestone systems. In this case we see no initial thermal activity, but the endothermic reaction generally attributed to the sulfite decomposition clearly consists of at least two components, although inadequately resolved. The hashed curve superimposed upon Figure 12B represents the thermal dehydration of the pure $\text{CaSO}_3 \cdot 0.5\text{H}_2\text{O}$ as prepared in our laboratory.

To date no correlation has been found between the temperature of reaction as measured here and quantities which would measure either SO_4 substitution (infrared spectrophotometric determination of substituted CaSO_4), or disturbances in the $\text{CaSO}_3 \cdot 0.5\text{H}_2\text{O}$ structure (the index of refraction, length of crystal axes, etc.)

Thermal analysis of lime/limestone scrubbing materials has been reported previously by Taylor.³ In these studies synthetic sludges were prepared by the addition of fly ash to mixtures of the pure components normally found in such sludges ($\text{CaSO}_3 \cdot 0.5\text{H}_2\text{O}$, $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$, CaCO_3 , etc.). These mixtures were studied by differential thermal analysis (DTA), and thermogravimetric analysis (TGA); the $\text{CaSO}_3 \cdot 0.5\text{H}_2\text{O}$ was found to undergo dehydration in the region 350-410°C. This compares favorably with our results which indicate an average decomposition temperature of approximately 390°C. These values represent a deviation from the dehydration temperature of 367°C for the pure compound as reported by Schropfer⁴ utilizing DTA. DSC investigation of the pure compound as prepared in our laboratory indicates a decomposition temperature of 364°C.

It is not clear which aspects of the complex thermal behavior of the samples examined to date are a result of matrix effects and which may be assigned to reactions of carbonate- or sulfate-substituted $\text{CaSO}_3 \cdot 0.5\text{H}_2\text{O}$ species. Studies in progress are intended to clarify this information. The resolution of the thermograms may be improved by increasing the partial pressure of CO_2 or H_2O in the purge gas. Assuming that the thermally induced reactions include those that liberate CO_2 or H_2O , an increase in either of these components in the sample atmosphere should act to displace the reaction equilibrium temperature and thus "spread out" the various components of the thermogram.

SECTION 8

DATA HANDLING AND ANALYSIS

A system of computer programs has been written to establish and maintain a slurry sample data base containing all numeric data obtained from this characterization study and selected analytical and operating data supplied by the Shawnee Test Facility. The purpose of this data is to provide machine readable files which may be used in ongoing statistical data analysis and report generation while also allowing interactive file updating and correction capabilities. TVA installation and laboratory-supplied software is used to access the information in these files for the above purposes via a time-sharing computer terminal located in the laboratory.

Numerical or statistical analysis to determine relationships between the chemical and physical properties of the scrubbing slurries and solids and scrubber operating parameters has proceeded along the following lines:

1. Attempts to determine relationships between factors associated with sludge handling (i.e., settling rates, settled bulk densities, ultimate settled percent solids) and operating or chemical parameters (percent fly ash, average particle size and morphology, absorbent used, hold tank residence time, etc.).
2. Efforts to relate sulfate substitution (as indicated by variations in the index of refraction, length of crystallographic axes, etc.) to chemical composition (measured by weight percent sulfate, stoichiometry, saturation ratio, pH, etc.).
3. An evaluation of general system operation as functions of absorbent used, make/pass ratio, L/G ratio, etc.

In the analyses performed to date some trends have been indicated, but no unusual significant results have been observed. A factor that plays an extremely strong role in masking possible correlations is the solids response time. Assuming an abrupt change in adsorbent or additive feed or in scrubber operating conditions, the time required for the solids as a mass to adjust to this change and establish a new equilibrium in terms of chemical composition or morphology will range from one to three days. The importance of this effect is that a chemical analysis of components in the scrubbing liquor, or a synopsis of scrubber operating conditions at a given point in time

may have little to do with the chemical composition and morphology of the solids at that time. Rather, the characteristics of the solids will be functions of liquor chemistry and scrubber operation averaged over a preceding period of time. Under these conditions, time correlations of solids properties with liquor chemistry and scrubber operating conditions will be meaningful only if the chemical composition and morphology are representative of some prior finite period of operation.

Analyses of this data are continuing, particularly with regard to point 1 above, concerning sludge handling properties. Multivariate relationships between variables such as slurry percent fly ash, settling rates, settled percent solids, etc., are currently under investigation.

REFERENCES

1. Borgwardt, H. R., "Limestone Scrubbing of SO_2 at EPA Pilot Plant," Progress Report, June 11, 1973.
2. Grob, et al. (American Laboratory, 1(6), 13-25 (1975)).
3. Taylor, (Combustion 45(4), 15-22 (1973)).
4. Schropfer, (Zeitschrift Fur Anorg. Und Allg. Chemie 401 (1), 1-14 (1973)).

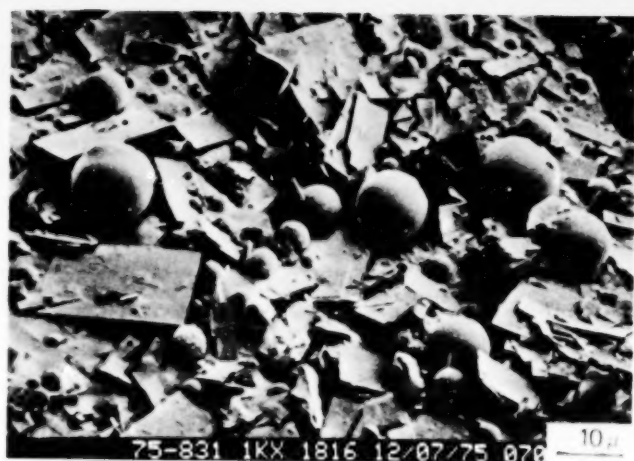


Figure 1A

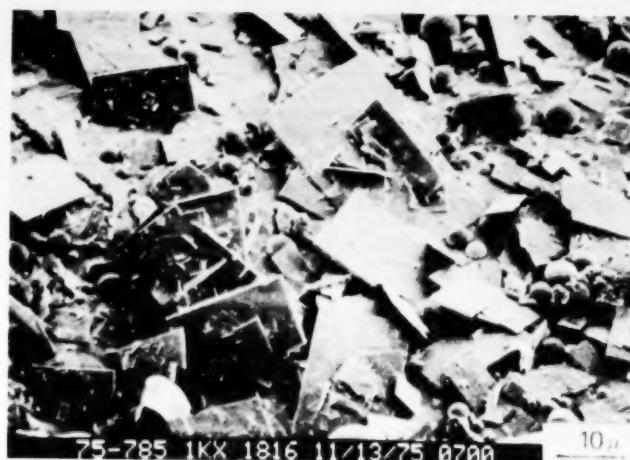


Figure 1B



Figure 1C

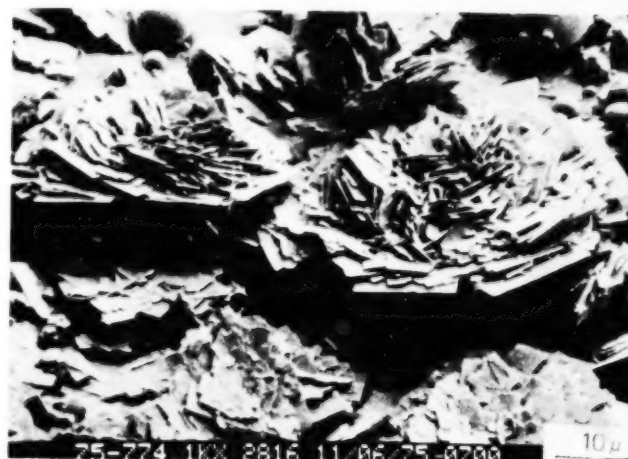


Figure 1D



Figure 1E

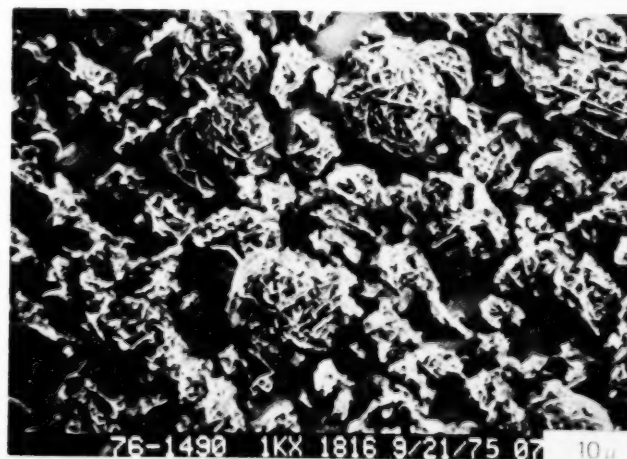


Figure 1F



Figure 2A



Figure 2B



Figure 2C

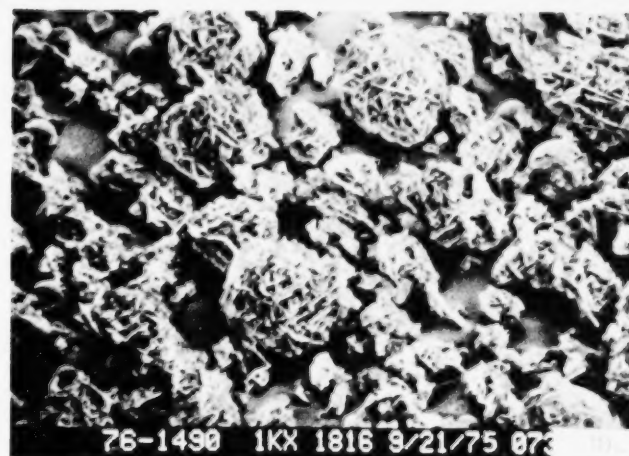


Figure 2D

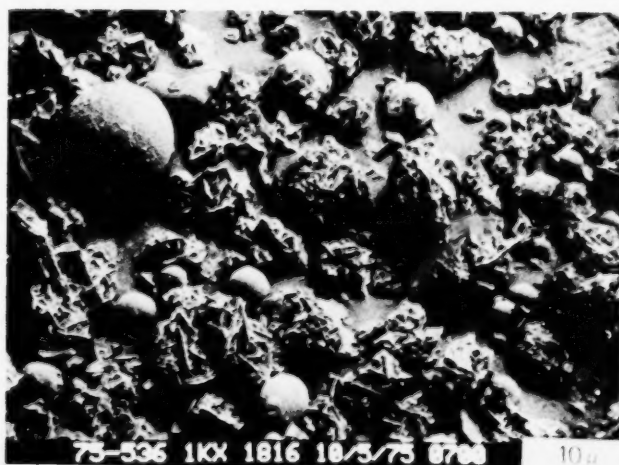


Figure 2E



Figure 2F



Figure 3A



Figure 3B

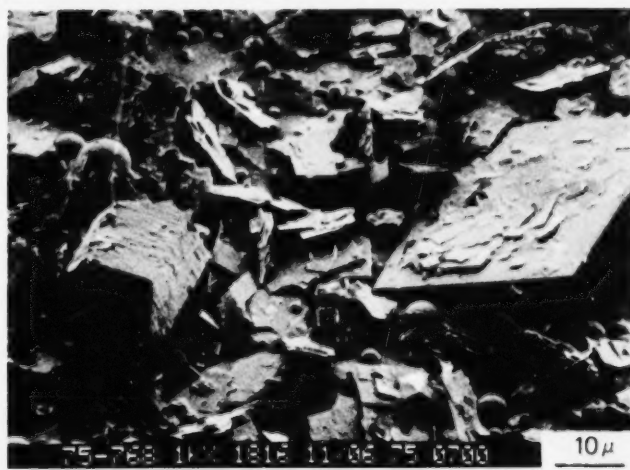


Figure 3C



Figure 3D



Figure 3E



Figure 3F

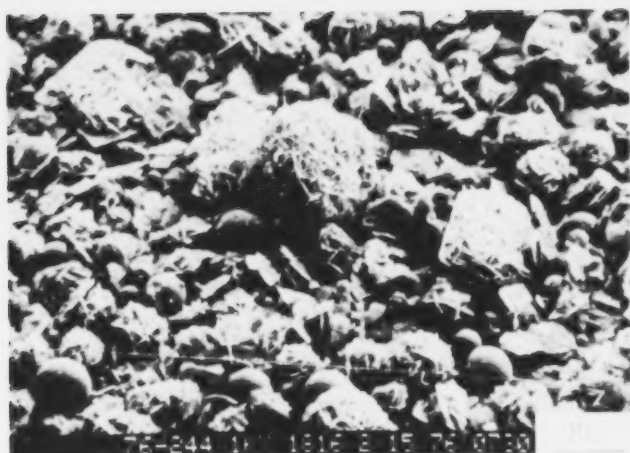


Figure 4A



Figure 4B

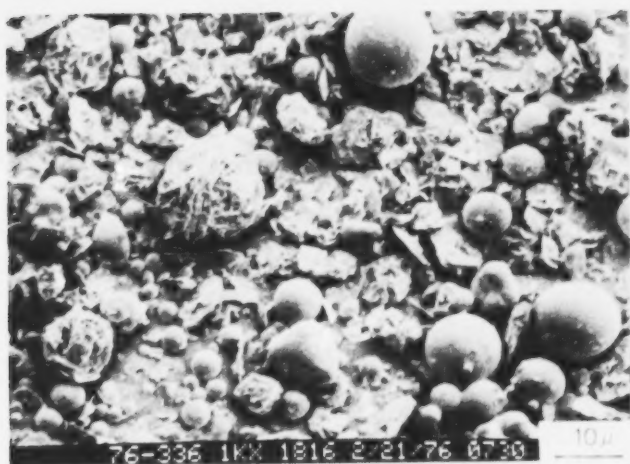


Figure 4C

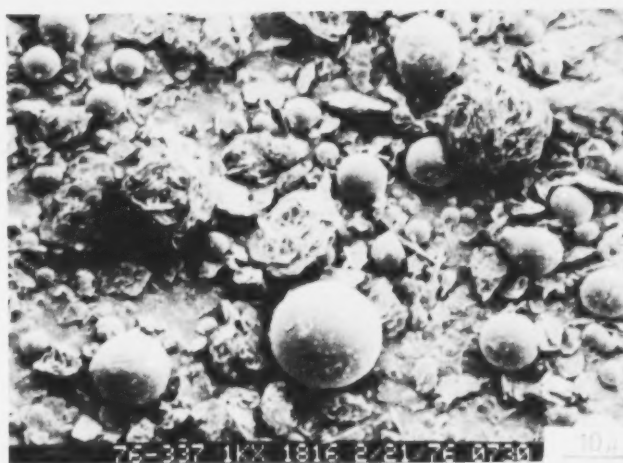


Figure 4D



Figure 4E



Figure 4F

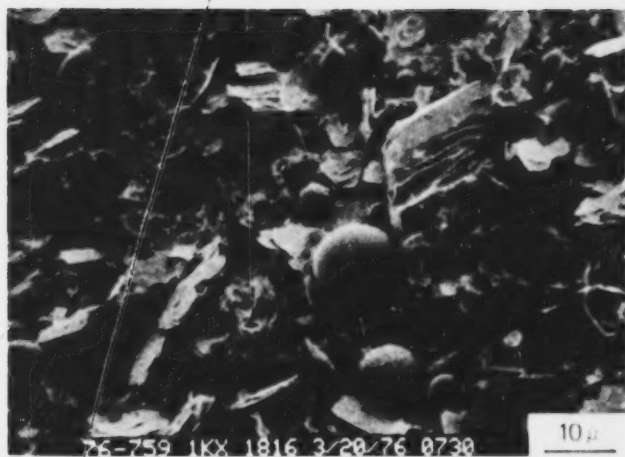


Figure 5A



Figure 5B



Figure 5C



Figure 5D



Figure 5E

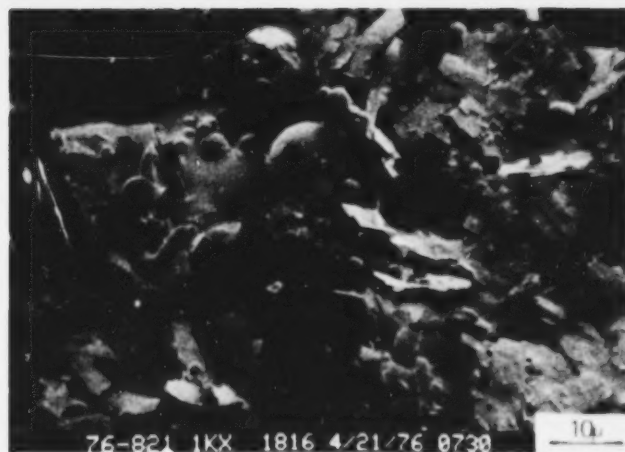


Figure 5F



Figure 6A



Figure 6B

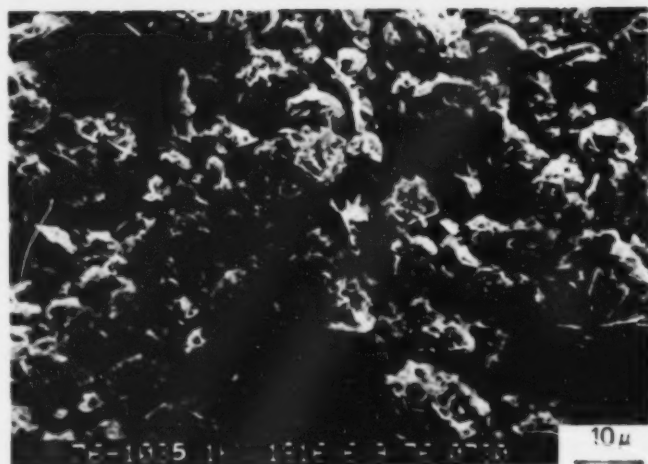


Figure 6C

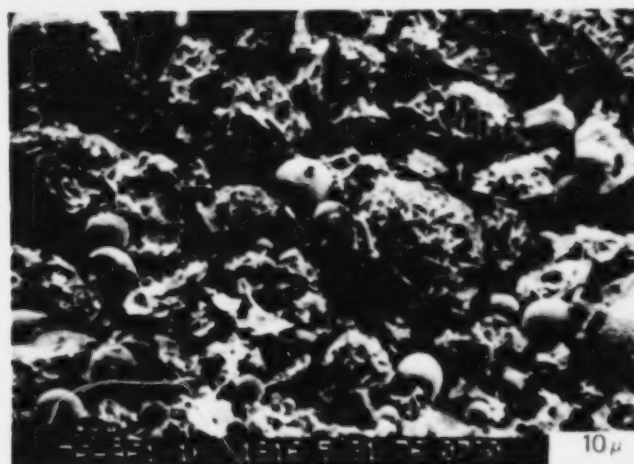


Figure 6D



Figure 6E



Figure 6F



Figure 7A
Stoic.=0.98



Figure 7B
Stoic.=1.06



Figure 7C
Stoic.=1.13

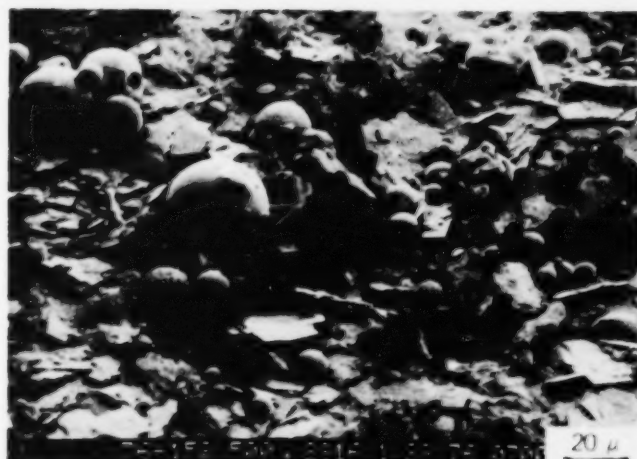


Figure 7D
Stoic.=1.27

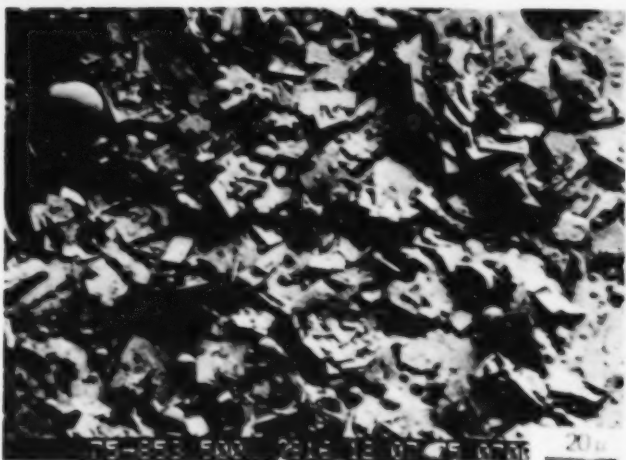


Figure 7E
Stoic.=1.43

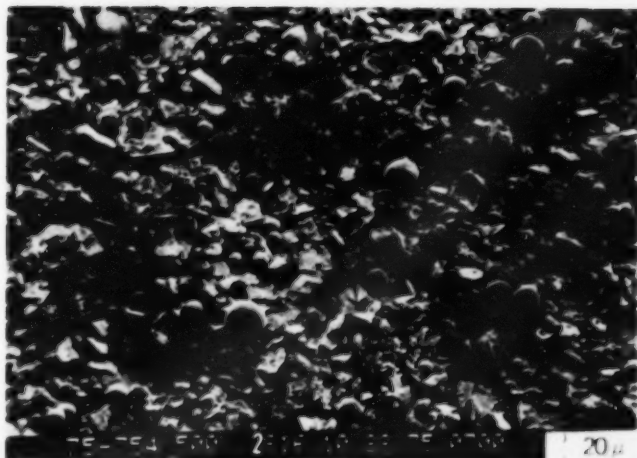


Figure 7F
Stoic.=1.63

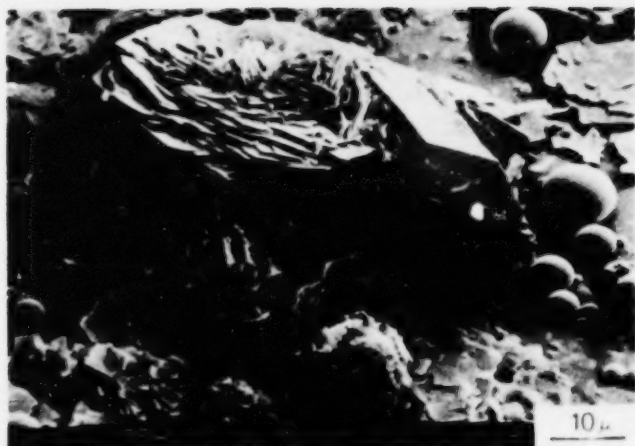


Figure 8A

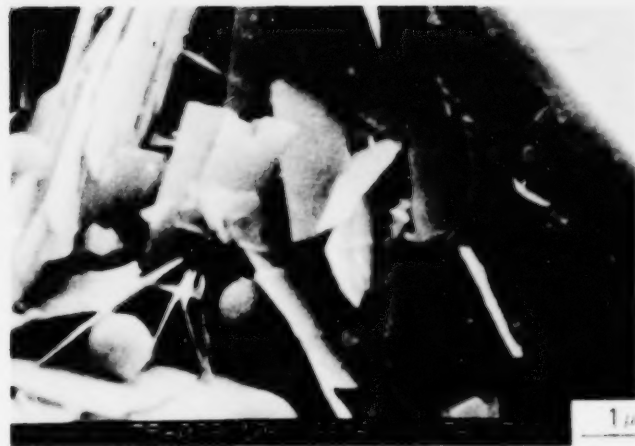


Figure 8B

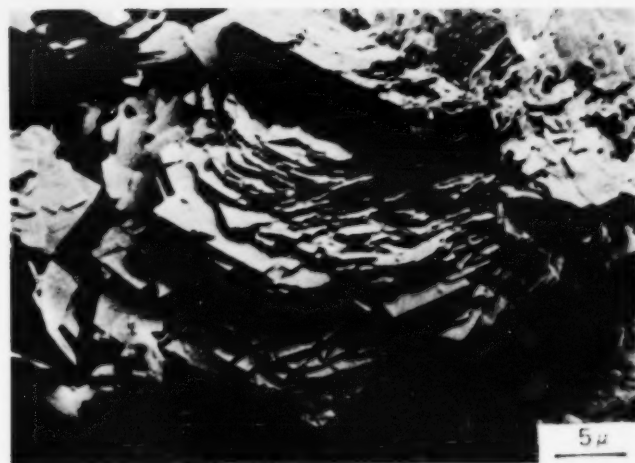


Figure 8C

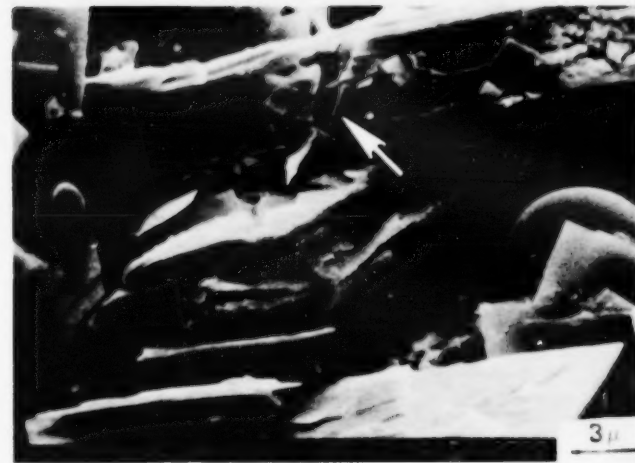


Figure 8D



Figure 9A



Figure 9B



Figure 9C



Figure 9D

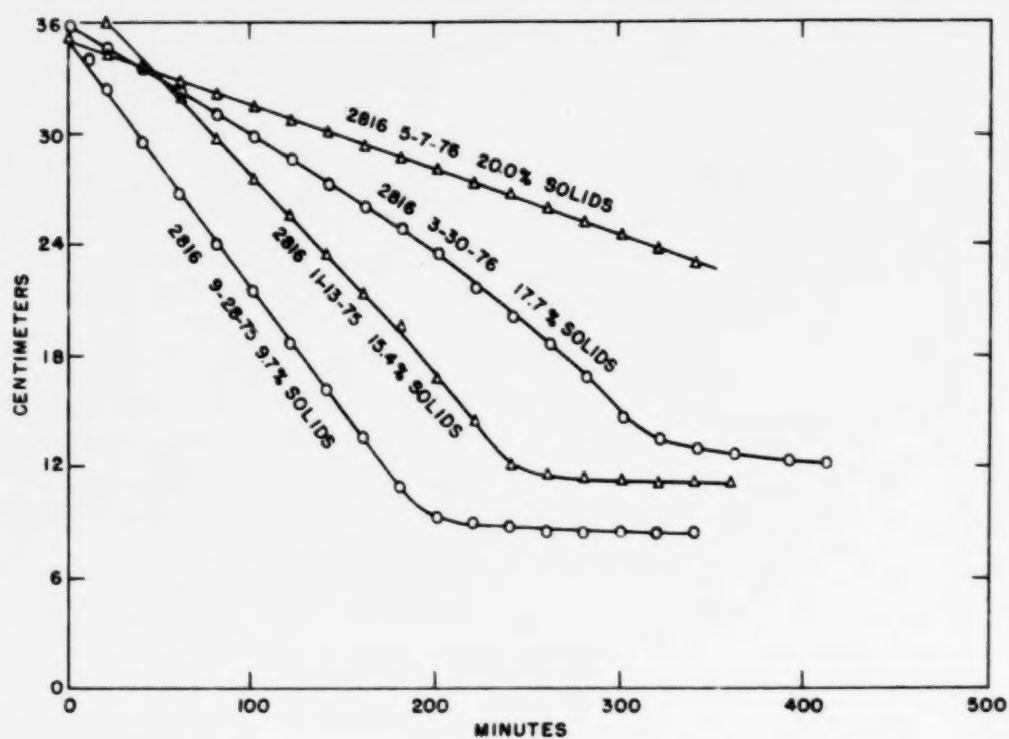


FIGURE 10A

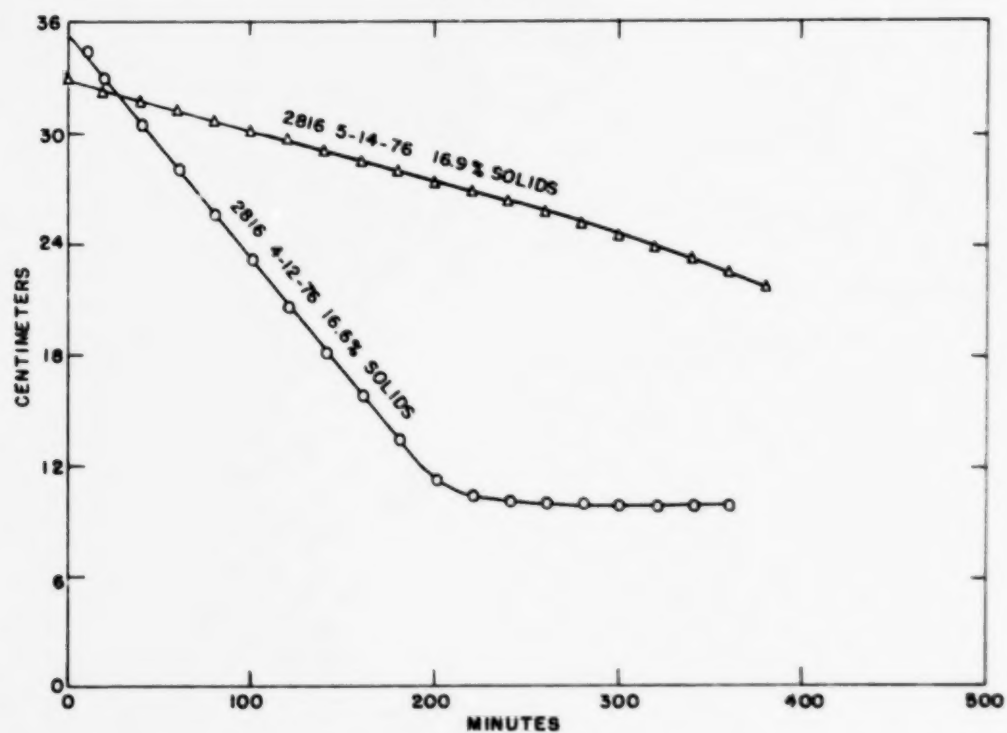


FIGURE 10B

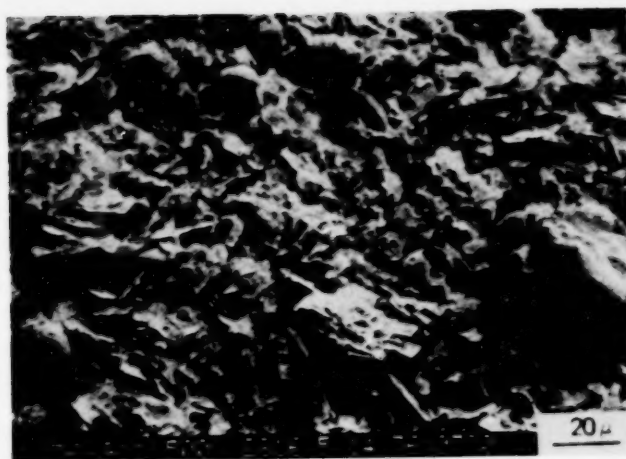


Figure 11A



Figure 11B

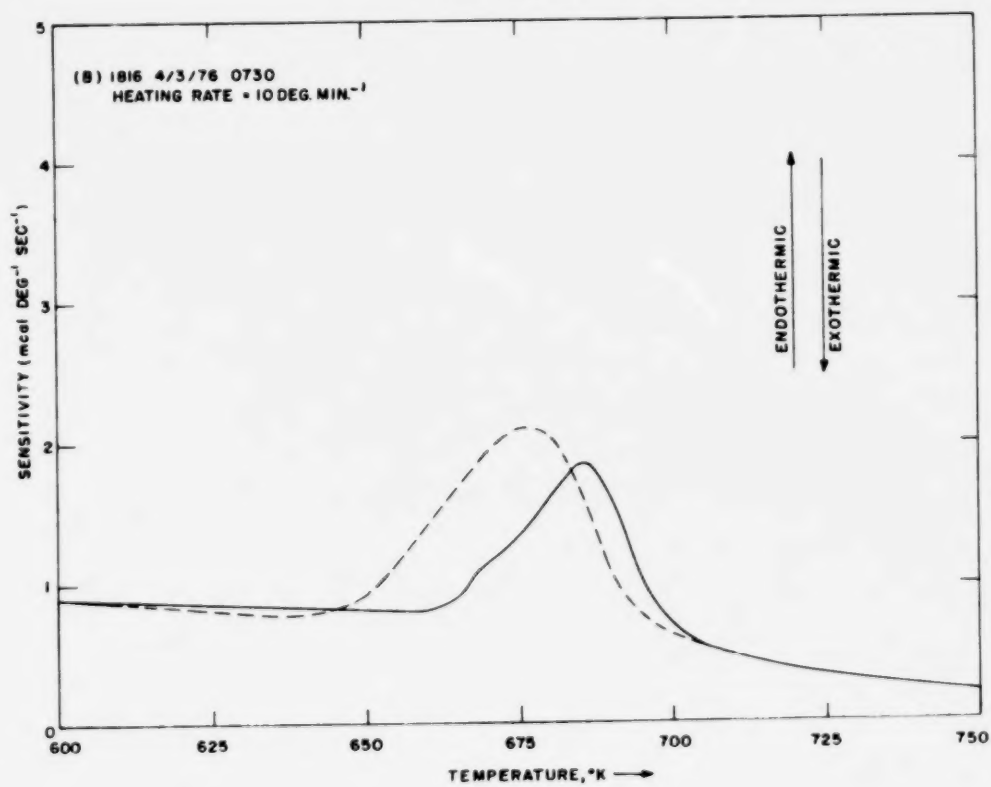
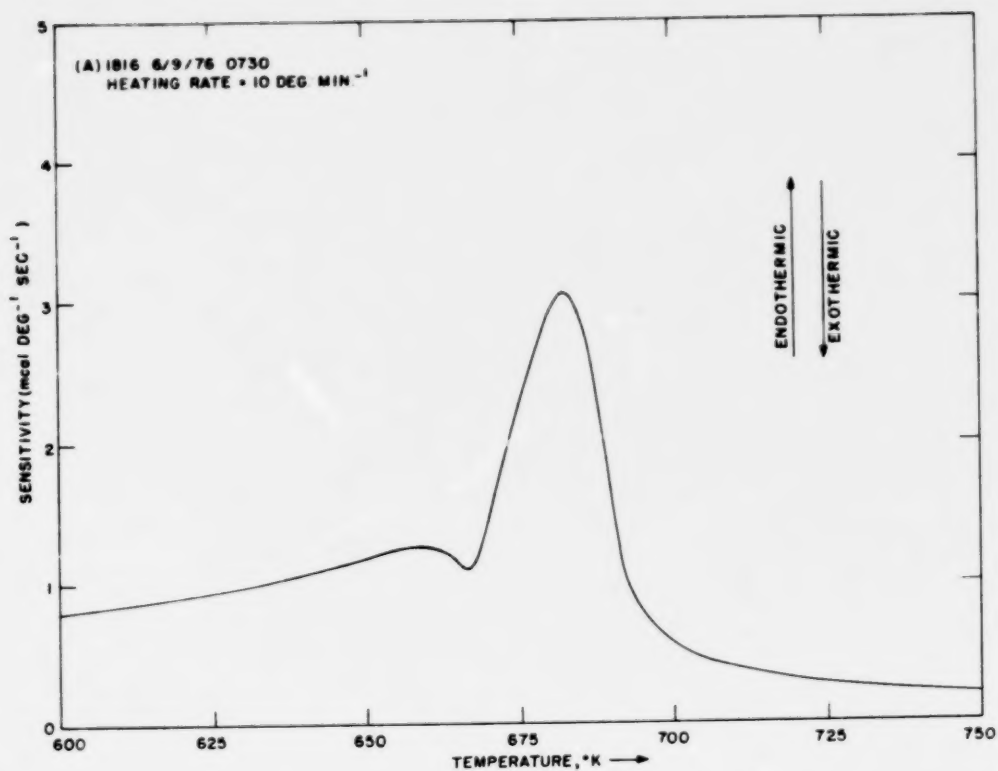


FIGURE 12

TABLE 1. TCA SLURRY ANALYSES

RUN NUMBER	539-2A	539-2A	541-2A	546-2A	546-2A	546-2A
ANALYSIS POINT	2816	2816	2816	2816	2816	2816
DATE	031375	031475	032675	061175	061275	061775
TIME	1300	1300	1500	1500	0700	0700
ADSORBENT	LS	LS	LS	LS	LS	LS
FIGURE	-	-	-	-	-	-
ON-SITE SOLIDS ANALYSES						
ASH (WT %)	32.08	32.32	26.90	51.50	44.20	36.21
CA (WT %)	31.33	31.38	34.96	23.92	25.84	30.18
SO ₂ (WT %)	15.81	18.11	19.91	19.03	22.05	25.95
SO ₃ (WT %)	7.08	6.05	8.11	3.46	4.42	1.66
CO ₂ (WT %)	11.36	11.25	12.06	2.55	3.78	5.21
TVA SOLIDS CHARACTERIZATION						
ASH (WT %, ACID INSOLUBLE)	25.0	33.0	29.0	43.3	43.3	26.7
CACD ₃ (WT %, BY IR)	32.0	28.0	33.0	11.6	13.3	16.9
CASO ₃ X .5 H ₂ O (WT %, IR)	36.0	39.0	29.0	34.7	32.1	48.0
CASO ₄ X 2H ₂ O (WT %, IR)	6.8	0.0	8.7	10.4	11.3	8.4
SURFACE AREA (SQ M/GM)	3.8	4.4	3.5	2.8	2.6	2.5
TVA SLURRY CHARACTERIZATION						
SLURRY SOLIDS %	15.5	13.5	13.9	14.9	15.9	15.6
SETTLED % SOLIDS	44.7	35.6	34.3	54.4	38.8	40.6
SETTLED BULK DENSITY (GM/CC)	1.22	1.24	1.25	1.28	1.28	1.32
SETTLING RATE (CM/HR)	5.0	6.7	3.4	6.6	4.8	5.3
TVA CRYSTALLOGRAPHIC ANALYSES						
SULFITE REFRACTIVE INDEX	1.590	1.590	1.591	1.590	1.590	1.593
SULFITE A AXIS	9.790	9.798	9.780	9.795	9.790	9.800
STD. ERROR	0.017	0.016	0.028	0.006	0.010	0.015
SULFITE B AXIS	10.678	10.661	10.640	10.695	10.694	10.680
STD. ERROR	0.010	0.009	0.014	0.007	0.012	0.014
SULFITE C AXIS	6.503	6.492	6.491	6.551	6.518	6.515
STD. ERROR	0.008	0.008	0.012	0.004	0.010	0.012
SCRUBBER OPERATIONAL PARAMETERS						
% SOLID OXIDATION	26.40	0.0	28.90	12.70	13.80	10.10
SAT. RATIO (RADIAN 50 C.)	0.0	0.0	1.08	1.21	1.10	0.40
STOIC. RATIO	1.67	1.56	1.76	1.25	1.15	1.14
SLURRY PH	6.00	6.00	5.85	5.70	5.65	5.95
SLURRY TEMPERATURE (C)	50.0	52.0	52.0	50.0	52.0	50.0
MAKE/PASS (MOLES/THOUS GAL)	0.0	0.0	0.0	60.0	86.5	107.4
LIQ/GAS (GAL/THOUS CFM)	0.0	0.0	0.0	33.4	34.1	33.9
WT % CL IN LIQUOR	0.19	0.16	0.15	0.33	0.26	0.20
WT % MG IN LIQUOR	0.03	0.03	0.03	0.02	0.03	0.03
HOLD TANK RES. TIME (MINS)	25.0	25.0	15.0	15.0	15.0	15.0

NOTE: A VALUE OF "0.0" INDICATES EITHER DATA NOT AVAILABLE OR WORK IN PROGRESS

TABLE 1, CONTD. TEA SLURRY ANALYSES

RUN NUMBER	557-2A	559-2A	559-2A	560-2A	561-2A	562-2A
ANALYSIS POINT	2816	2816	2816	2816	2816	2816
DATE	080875	091475	092175	092875	100575	101275
TIME	1426	0700	0700	0700	0700	0700
ADSORBENT	LS	LS	LS	LS	LS	LS
FIGURE	-	-	-	-	-	1C
ON-SITE SOLIDS ANALYSES						
ASH (WT %)	44.42	39.77	44.49	37.52	37.82	33.47
CA (WT %)	27.05	28.93	27.89	30.29	28.73	30.42
SO2 (WT %)	14.80	17.30	15.01	21.32	22.42	20.18
SO3 (WT %)	5.61	4.95	5.84	3.70	5.02	7.43
CO2 (WT %)	8.50	8.66	8.65	7.78	6.13	7.26
TVA SOLIDS CHARACTERIZATION						
ASH (WT %, ACID INSOLUBLE)	42.0	35.0	30.0	35.7	29.0	28.0
CACO3 (WT %, BY IR)	14.6	20.1	18.1	35.7	16.1	18.6
CASO3 X .5 H2O (WT %, IR)	32.5	35.9	42.2	30.7	46.2	45.6
CASO4 X 2H2O (WT %, IR)	10.9	9.0	9.7	8.4	8.7	7.7
SURFACE AREA (SQ M/GH)	2.4	3.7	2.8	3.4	2.5	2.7
TVA SLURRY CHARACTERIZATION						
SLURRY SOLIDS %	15.5	16.2	16.1	9.7	15.1	15.3
SETTLED % SOLIDS	46.7	39.9	39.6	35.8	40.9	39.8
SETTLED BULK DENSITY (GM/CC)	1.32	1.30	1.28	1.24	1.26	1.29
SETTLING RATE (CM/HR)	7.3	4.3	4.7	7.9	5.8	5.0
TVA CRYSTALLOGRAPHIC ANALYSES						
SULFITE REFRACTIVE INDEX	1.591	1.589	1.591	1.590	1.589	1.590
SULFITE A AXIS	9.791	9.786	9.787	9.792	9.797	9.794
STD. ERROR	0.009	0.008	0.003	0.017	0.006	0.006
SULFITE B AXIS	10.730	10.700	10.697	10.693	10.697	10.697
STD. ERROR	0.010	0.008	0.005	0.012	0.006	0.006
SULFITE C AXIS	6.517	6.520	6.517	6.510	6.514	6.514
STD. ERROR	0.008	0.006	0.004	0.010	0.005	0.005
SCRUBBER OPERATIONAL PARAMETERS						
% SOLID OXIDATION	23.27	18.60	23.70	12.10	15.10	22.80
SAT. RATIO (RADIAN 50 C.)	0.97	0.46	0.43	0.37	0.35	0.49
STOIC. RATIO	1.60	1.55	1.62	1.42	1.24	1.33
SLURRY PH	5.95	6.05	5.40	5.70	5.95	5.85
SLURRY TEMPERATURE (C)	54.0	52.0	53.0	50.0	50.0	54.0
MAKE/PASS (MOLES/THOUS GAL)	83.5	85.9	92.8	0.0	89.8	79.2
LIQ/GAS (GAL/THOUS CFM)	40.9	40.3	40.0	42.0	40.0	40.5
WT % CL IN LIQUOR	0.18	0.18	0.19	0.17	0.0	0.22
WT % HG IN LIQUOR	0.03	0.03	0.04	0.04	0.0	0.03
HOLD TANK RES. TIME (MINS)	15.0	15.0	15.0	15.0	15.0	12.0

NOTE: A VALUE OF "0.0" INDICATES EITHER DATA NOT AVAILABLE OR WORK IN PROGRESS

TABLE 1, CONTD. TCA SLURRY ANALYSES

RUN NUMBER	562-2A	562-2A	562-2A	563-2A	564-2A	565-2A
ANALYSIS POINT	2816	2816	2816	2816	2816	2816
DATE	102175	102875	110675	111375	111875	112875
TIME	0700	0900	0700	0700	0700	0700
ADSORBENT	LS	LS	LS	LS	LS	LS
FIGURE	-	7F	1D	-	7B	-
ON-SITE SOLIDS ANALYSES						
ASH (WT %)	0.0	34.32	36.91	32.80	48.57	36.36
CA (WT %)	31.20	32.78	29.27	30.71	24.18	28.89
SO2 (WT %)	18.62	20.53	23.13	19.59	22.93	20.98
SO3 (WT %)	6.12	3.06	4.48	5.01	3.78	7.35
CO2 (WT %)	6.15	10.10	6.73	11.75	1.35	5.55
TVA SOLIDS CHARACTERIZATION						
ASH (WT %, ACID INSOLUBLE)	29.0	27.0	33.0	25.0	40.0	24.0
CACO3 (WT %, BY IR)	21.3	29.2	18.5	30.1	2.0	9.8
CASO3 X .5 H2O (WT %, IR)	41.2	38.7	39.3	35.4	48.1	54.2
CASO4 X 2H2O (WT %, IR)	8.5	5.1	8.2	10.0	13.8	11.0
SURFACE AREA (SQ M/GM)	3.5	2.4	3.0	3.0	3.3	3.7
TVA SLURRY CHARACTERIZATION						
SLURRY SOLIDS %	14.2	21.9	15.2	15.4	13.8	14.0
SETTLED % SOLIDS	39.4	45.2	38.7	43.8	41.0	34.0
SETTLED BULK DENSITY (GM/CC)	1.25	1.35	1.28	1.36	1.29	1.27
SETTLING RATE (CM/HR)	4.6	3.6	5.7	6.7	7.5	4.8
TVA CRYSTALLOGRAPHIC ANALYSES						
SULFITE REFRACTIVE INDEX	1.589	1.590	1.589	1.593	1.592	1.590
SULFITE A AXIS	9.788	9.802	9.774	9.799	9.790	9.779
STD. ERROR	0.007	0.005	0.007	0.004	0.004	0.003
SULFITE B AXIS	10.702	10.683	10.690	10.683	10.665	10.665
STD. ERROR	0.007	0.005	0.006	0.004	0.004	0.004
SULFITE C AXIS	6.512	6.506	6.518	6.508	6.510	6.510
STD. ERROR	0.005	0.004	0.004	0.003	0.003	0.002
SCRUBBER OPERATIONAL PARAMETERS						
% SOLID OXIDATION	20.80	10.60	13.40	16.90	11.60	21.90
SAT. RATIO (RADIAN 50 C.)	0.0	0.19	0.39	0.32	0.10	0.67
STOIC. RATIO	1.52	1.63	1.25	1.49	1.06	1.22
SLURRY PH	5.80	5.82	5.66	6.15	5.25	5.95
SLURRY TEMPERATURE (C)	50.0	51.0	52.0	52.0	50.0	51.0
MAKE/PASS (MOLES/THOUS GAL)	84.6	86.6	88.6	99.1	63.6	84.0
LIQ/GAS (GAL/THOUS CFM)	40.3	40.0	40.2	39.5	40.2	41.2
WT % CL IN LIQUOR	0.0	0.30	0.25	0.17	0.21	0.29
WT % MG IN LIQUOR	0.0	0.04	0.44	0.04	0.03	0.05
HOLD TANK RES. TIME (MINS)	12.0	12.0	12.0	12.0	12.0	14.8

NOTE: A VALUE OF "0.0" INDICATES EITHER DATA NOT AVAILABLE OR WORK IN PROGRESS

TABLE 1, CONTD. TCA SLURRY ANALYSES

RUN NUMBER	567-2A	568-2A	570-2A	571-2A	568-2B	575-2A
ANALYSIS POINT	2816	2816	2816	2816	2816	2816
DATE	120775	127475	122575	010176	011076	011676
TIME	0700	0700	0700	0700	0700	0730
ADSORBENT	LS	LS	LS	LS	LS	LS
FIGURE	7E	7A	-	9A,9B 8A,8B	9C 7C	-
ON-SITE SOLIDS ANALYSES						
ASH (WT %)	35.80	51.86	48.35	47.80	50.40	47.24
CA (WT %)	30.57	21.48	24.70	24.65	23.16	24.89
SO2 (WT %)	20.82	21.54	22.56	16.98	19.01	24.28
SO3 (WT %)	4.36	4.38	2.81	5.43	5.59	3.52
CO2 (WT %)	8.69	1.24	2.79	4.46	1.39	1.17
TVA SOLIDS CHARACTERIZATION						
ASH (WT %, ACID INSOLUBLE)	30.0	27.0	32.0	42.0	47.0	32.5
CACO3 (WT %, BY IR)	19.7	4.8	17.6	8.1	2.3	4.4
CASO3 X .5 H2O (WT %, IR)	43.9	55.5	44.1	42.4	43.8	51.8
CASO4 X 2H2O (WT %, IR)	6.4	12.7	6.8	7.5	6.9	11.3
SURFACE AREA (SQ M/GM)	2.8	1.6	2.5	3.5	2.7	3.6
TVA SLURRY CHARACTERIZATION						
SLURRY SOLIDS %	15.7	15.5	14.2	14.9	16.2	14.7
SETTLED % SOLIDS	42.8	41.6	42.0	38.7	39.2	39.8
SETTLED BULK DENSITY (GM/CC)	1.34	1.31	1.33	1.29	1.28	1.26
SETTLING RATE (CM/HR)	6.3	8.0	4.3	6.3	5.4	6.9
TVA CRYSTALLOGRAPHIC ANALYSES						
SULFITE REFRACTIVE INDEX	1.590	1.591	1.593	1.590	0.0	1.592
SULFITE A AXIS	9.789	9.794	9.785	9.783	9.786	9.816
STD. ERROR	0.002	0.005	0.004	0.002	0.003	0.005
SULFITE B AXIS	10.662	10.670	10.661	10.666	10.677	10.649
STD. ERROR	0.003	0.006	0.005	0.002	0.004	0.005
SULFITE C AXIS	6.495	6.506	6.504	6.519	6.515	6.523
STD. ERROR	0.002	0.003	0.003	0.001	0.002	0.003
SCRUBBER OPERATIONAL PARAMETERS						
% SOLID OXIDATION	14.30	14.00	9.08	20.40	19.00	10.40
SAT. RATIO (RADIAN 50 C.)	0.26	0.83	1.12	1.11	1.15	0.95
STOIC. RATIO	1.43	0.99	1.14	1.32	1.13	1.05
SLURRY PH	6.02	5.49	5.79	5.74	5.48	5.49
SLURRY TEMPERATURE (C)	50.0	52.0	50.0	52.0	50.0	50.0
MAKE/PASS (MOLES/THOUS GAL)	84.1	64.5	64.0	75.5	56.7	71.9
LIQ/GAS (GAL/THOUS CFM)	40.9	41.1	39.1	40.2	41.0	41.1
WT % CL IN LIQUOR	0.24	0.17	0.20	0.31	0.39	0.32
WT % MG IN LIQUOR	0.05	0.05	0.05	0.04	0.06	0.06
HOLD TANK RES. TIME (MINS)	14.8	14.8	10.8	10.8	14.8	14.8

NOTE: A VALUE OF "0.0" INDICATES EITHER DATA NOT AVAILABLE OR WORK IN PROGRESS

TABLE 1, CONTD. TCA SLURRY ANALYSES

RUN NUMBER	577-2A	579-2A	581-2A	FACT.	FACT.	FACT.
ANALYSIS POINT	2816	2816	2816	2816	2816	2816
DATE	012376	020176	020876	021676	022276	030176
TIME	0700	0730	0730	0730	0730	0730
ADSORBENT	LS	LS	LS	LS	LS	LS
FIGURE	7D	-	-	-	-	-
ON-SITE SOLIDS ANALYSES						
ASH (WT %)	46.83	49.16	58.89	38.20	45.43	0.0
CA (WT %)	25.98	22.05	25.47	31.01	25.20	0.0
SO ₂ (WT %)	21.58	16.72	19.63	17.36	15.93	0.0
SO ₃ (WT %)	2.20	8.64	5.88	4.16	6.99	0.0
CO ₂ (WT %)	4.66	1.37	2.63	13.62	5.01	0.0
TVA SOLIDS CHARACTERIZATION						
ASH (WT %, ACID INSOLUBLE)	29.2	44.5	38.5	30.5	35.0	30.0
CACO ₃ (WT %, BY IR)	14.2	1.4	7.5	44.5	12.0	3.0
CASO ₃ X .5 H ₂ O (WT %, IR)	47.4	47.3	46.0	25.0	42.6	57.0
CASO ₄ X 2H ₂ O (WT %, IR)	9.2	6.8	8.0	0.0	10.4	10.0
SURFACE AREA (SQ M/GM)	3.1	3.3	4.9	3.8	2.4	5.0
TVA SLURRY CHARACTERIZATION						
SLURRY SOLIDS %	14.4	15.7	18.3	20.3	20.3	16.3
SETTLED % SOLIDS	37.0	44.6	45.6	55.6	53.6	46.4
SETTLED BULK DENSITY (GM/CC)	1.26	1.32	1.31	1.29	1.31	1.38
SETTLING RATE (CM/HR)	6.0	7.7	5.0	5.5	7.3	11.1
TVA CRYSTALLOGRAPHIC ANALYSES						
SULFITE REFRACTIVE INDEX	1.591	1.591	1.589	1.587	1.585	1.586
SULFITE A AXIS	9.800	9.795	9.793	9.762	9.788	9.775
STD. ERROR	0.003	0.004	0.004	0.003	0.003	0.004
SULFITE B AXIS	10.674	10.674	10.665	10.667	10.655	10.653
STD. ERROR	0.003	0.005	0.005	0.004	0.003	0.004
SULFITE C AXIS	6.511	6.515	6.512	6.508	6.512	6.507
STD. ERROR	0.002	0.003	0.003	0.002	0.002	0.003
SCRUBBER OPERATIONAL PARAMETERS						
% SOLID OXIDATION	7.54	29.20	19.30	21.20	26.60	0.0
SAT. RATIO (RADIAN 50 C.)	0.69	1.12	1.24	1.14	1.28	0.0
STOIC. RATIO	1.27	1.06	1.20	2.26	1.33	0.0
SLURRY PH	5.81	5.16	0.0	5.82	5.67	0.0
SLURRY TEMPERATURE (C)	50.0	50.0	0.0	52.0	52.0	0.0
MAKE/PASS (MOLES/THOUS GAL)	96.0	56.0	73.3	73.1	68.4	55.7
LIQ/GAS (GAL/THOUS CFM)	41.1	41.0	40.3	24.9	36.2	46.5
WT % CL IN LIQUOR	0.34	0.24	0.48	0.61	0.65	0.0
WT % MG IN LIQUOR	0.05	0.04	0.05	0.05	0.04	0.0
HOLD TANK RES. TIME (MINS)	14.8	10.8	12.0	6.0	6.0	12.0

NOTE: A VALUE OF "0.0" INDICATES EITHER DATA NOT AVAILABLE OR WORK IN PROGRESS

TABLE 1, CONTD. TEA SLURRY ANALYSES

RUN NUMBER	FACT.	FACT.	FACT	FACT	FACT	FACT
ANALYSIS POINT	2816	2816	2816	2816	2816	2816
DATE	030776	031576	032276	033076	041276	042276
TIME	0730	0730	0700	0730	0730	0730
ADSORBENT	LINE	LS	LS	LS	LS	LS
FIGURE	1E	-	-	-	11B	-
ON-SITE SOLIDS ANALYSES						
ASH (WT %)	46.38	48.67	48.81	43.32	39.52	37.69
CA (WT %)	25.02	23.32	24.70	27.46	30.39	27.91
SO ₂ (WT %)	20.53	15.75	16.48	16.56	20.08	15.56
SO ₃ (WT %)	5.78	8.88	7.53	6.40	5.30	10.58
CO ₂ (WT %)	0.93	1.32	1.10	5.93	4.78	5.50
TVA SOLIDS CHARACTERIZATION						
ASH (WT %, ACID INSOLUBLE)	39.0	38.0	39.0	35.0	30.0	30.0
CACO ₃ (WT %, BY IR)	3.0	4.0	7.0	14.0	9.0	14.0
CASO ₃ X .5 H ₂ O (WT %, IR)	49.0	46.0	40.0	41.0	51.0	44.0
CASO ₄ X 2H ₂ O (WT %, IR)	9.0	12.0	14.0	10.0	10.0	12.0
SURFACE AREA (SQ M/GM)	7.3	4.2	5.3	4.2	3.3	5.3
TVA SLURRY CHARACTERIZATION						
SLURRY SOLIDS %	16.7	15.6	18.0	17.7	16.6	16.6
SETTLED % SOLIDS	42.6	40.4	47.7	48.1	68.3	45.6
SETTLED BULK DENSITY (GM/CC)	1.30	1.30	1.31	1.37	1.42	1.28
SETTLING RATE (CM/HR)	3.6	3.7	3.8	3.5	7.6	2.4
TVA CRYSTALLOGRAPHIC ANALYSES						
SULFITE REFRACTIVE INDEX	1.585	1.588	1.587	1.588	1.590	1.589
SULFITE A AXIS	9.772	9.791	9.774	9.791	9.787	9.799
STD. ERROR	0.002	0.002	0.003	0.001	0.002	0.003
SULFITE B AXIS	10.662	10.670	10.667	10.650	10.667	10.675
STD. ERROR	0.002	0.003	0.003	0.001	0.003	0.003
SULFITE C AXIS	6.504	6.510	6.521	6.522	6.517	6.504
STD. ERROR	0.001	0.002	0.002	0.001	0.002	0.002
SCRUBBER OPERATIONAL PARAMETERS						
% SOLID OXIDATION	13.50	31.10	26.77	23.40	17.40	35.00
SAT. RATIO (RADIAN 50 C.)	1.42	1.13	1.57	1.02	0.93	1.22
STDIC. RATIO	1.14	1.14	1.25	1.45	1.42	1.33
SLURRY PH	5.73	5.03	5.24	5.53	5.83	5.41
SLURRY TEMPERATURE (C)	50.0	50.0	51.0	52.0	50.0	52.0
MAKE/PASS (MOLES/THOUS GAL)	54.4	37.6	50.1	82.4	78.7	80.1
LIQ/GAS (GAL/THOUS CFM)	47.3	48.3	48.4	30.7	36.6	41.7
WT % CL IN LIQUOR	0.78	0.88	1.39	1.61	0.98	0.48
WT % MG IN LIQUOR	0.04	0.04	0.23	1.04	0.45	0.68
HOLD TANK RES. TIME (MINS)	6.0	6.0	6.0	9.0	9.0	12.0

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TABLE 1, CONTD. TCA SLURRY ANALYSES

RUN NUMBER	583-2B	584-2A	584-2A	586-2A	587-2A	587-2A
ANALYSIS POINT	2816	2816	2816	2816	2816	2816
DATE	043076	050776	051476	052276	060176	061076
TIME	0730	0730	0730	0730	0730	0730
ADSORBENT	LS	LS	LS	LS	LS	LS
FIGURE	-	-	11A	-	-	-
ON-SITE SOLIDS ANALYSES						
ASH (WT %)	35.63	37.27	36.00	50.67	54.55	42.46
CA (WT %)	23.16	31.27	33.24	14.47	26.62	26.76
SO2 (WT %)	19.90	16.14	19.82	17.37	8.68	10.47
SO3 (WT %)	9.41	5.80	8.79	2.36	0.01	10.69
CO2 (WT %)	5.06	10.02	12.01	6.16	12.04	5.99
TVA SOLIDS CHARACTERIZATION						
ASH (WT %, ACID INSOLUBLE)	25.0	28.0	25.0	40.0	45.0	33.0
CACD3 (WT %, PY IR)	9.0	19.0	31.0	16.0	33.0	3.0
CASO3 X .5 H2O (WT %, IR)	53.0	45.0	37.0	35.0	12.0	56.0
CASO4 X 2H2O (WT %, IR)	13.0	9.0	7.0	8.0	10.0	8.0
SURFACE AREA (SQ M/GM)	4.6	3.5	4.1	2.7	4.1	5.7
TVA SLURRY CHARACTERIZATION						
SLURRY SOLIDS %	15.9	20.0	16.9	15.6	10.5	10.1
SETTLED % SOLIDS	34.4	41.6	38.1	42.3	25.8	34.0
SETTLED BULK DENSITY (GM/CC)	1.25	1.28	1.31	1.31	1.17	1.28
SETTLING RATE (CM/HR)	2.4	2.1	1.5	3.5	2.5	5.6
TVA CRYSTALLOGRAPHIC ANALYSES						
SULFITE REFRACTIVE INDEX	1.589	1.587	1.586	1.589	1.589	1.587
SULFITE A AXIS	9.794	9.803	9.788	9.802	9.803	9.793
STD. ERROR	0.004	0.003	0.003	0.003	0.004	0.002
SULFITE B AXIS	10.686	10.656	10.658	10.663	10.649	10.677
STD. ERROR	0.004	0.003	0.004	0.003	0.004	0.003
SULFITE C AXIS	6.514	6.499	6.529	6.513	6.484	6.497
STD. ERROR	0.002	0.002	0.002	0.002	0.002	0.002
SCRUBBER OPERATIONAL PARAMETERS						
% SOLID OXIDATION	27.40	22.30	30.72	9.80	0.10	44.90
SAT. RATIO (RADIAN SO C.)	1.12	0.34	1.05	0.71	0.16	1.43
STOIC. RATIO	1.17	1.71	1.85	1.45	3.49	1.60
SLURRY PH	5.33	5.71	5.28	5.16	5.94	4.98
SLURRY TEMPERATURE (C)	50.0	50.0	51.0	50.0	50.0	51.0
MAKE/PASS (MOLES/THOUS GAL)	94.7	96.4	83.5	58.7	86.0	90.9
LIQ/GAS (GAL/THOUS CFM)	41.3	40.6	40.8	40.0	40.0	41.0
WT % CL IN LIQUOR	0.35	0.44	0.81	0.39	0.03	0.20
WT % MG IN LIQUOR	0.58	1.07	1.26	0.82	0.75	1.02
HOLD TANK RES. TIME (MINS)	3.0	3.0	3.0	3.0	3.0	4.1

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TABLE 3, CONTD. TCA SLURRY ANALYSES

RUN NUMBER	588-2A	589-2A
ANALYSIS POINT	2816	2816
DATE	061976	062876
TIME	0730	0730
ADSORBENT	LS	LS
FIGURE	-	-
ON-SITE SOLIDS ANALYSES		
ASH (WT %)	41.39	41.57
CA (WT %)	29.03	27.04
SO ₂ (WT %)	9.91	18.03
SO ₃ (WT %)	5.71	6.82
CO ₂ (WT %)	12.55	5.67
TVA SOLIDS CHARACTERIZATION		
ASH (WT %, ACID INSOLUBLE)	30.0	30.0
CACDS (WT %, BY IR)	36.0	11.0
CASO ₃ X .5 H ₂ O (WT %, IR)	20.0	48.0
CASO ₄ X 2H ₂ O (WT %, IR)	14.0	11.0
SURFACE AREA (SQ M/GM)	4.8	5.6
TVA SLURRY CHARACTERIZATION		
SLURRY SOLIDS %	15.2	15.1
SETTLED % SOLIDS	42.8	32.0
SETTLED BULK DENSITY (GM/CC)	1.36	1.26
SETTLING RATE (CM/HR)	3.0	2.4
TVA CRYSTALLOGRAPHIC ANALYSES		
SULFITE REFRACTIVE INDEX	1.587	1.588
SULFITE A AXIS	9.785	9.803
STD. ERROR	0.003	0.002
SULFITE B AXIS	10.668	10.667
STD. ERROR	0.004	0.002
SULFITE C AXIS	6.529	6.513
STD. ERROR	0.002	0.001
SCRUBBER OPERATIONAL PARAMETERS		
% SOLID OXIDATION	31.50	23.20
SAT. RATIO (RADIAN 50 C.)	1.15	1.06
STOIC. RATIO	2.28	1.31
SLURRY PH	5.43	5.32
SLURRY TEMPERATURE (C)	50.0	56.0
MAKE/PASS (MOLES/THOUS GAL)	55.0	97.6
LIQ/GAS (GAL/THOUS CFM)	60.1	40.7
WT % CL IN LIQUOR	0.51	0.14
WT % MG IN LIQUOR	1.13	1.11
HOLD TANK RES. TIME (MINS)	4.1	4.1

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TABLE 2. VENTURI SLURRY ANALYSES

RUN NUMBER	623-1A	623-1A	624-1A	624-1A	627-1A	628-1A
ANALYSIS POINT	1816	1816	1816	1816	1816	1816
DATE	031375	031475	040375	041175	080875	091475
TIME	1300	1300	700	1145	1220	0700
ADSORBENT	LIME	LIME	LIME	LIME	LIME	LIME
FIGURE	-	-	-	2A	-	-
ON-SITE SOLIDS ANALYSES						
ASH (WT %)	0.0	42.80	44.03	0.0	49.02	44.71
CA (WT %)	0.0	28.66	25.99	0.0	24.34	24.81
SO2 (WT %)	0.0	22.08	23.11	0.0	17.24	20.76
SO3 (WT %)	0.0	6.06	5.04	0.0	5.14	6.92
CO2 (WT %)	0.0	2.08	2.06	0.0	3.76	1.97
TVA SOLIDS CHARACTERIZATION						
ASH (WT %, ACID INSOLUBLE)	33.0	33.0	69.0	45.0	40.0	35.0
CACO3 (WT %, BY IR)	3.3	5.6	1.4	5.0	10.2	8.3
CASO3 X .5 H2O (WT %, IR)	59.0	53.0	27.0	45.0	38.4	43.3
CASO4 X 2H2O (WT %, IR)	4.5	9.0	2.0	7.2	11.4	13.4
SURFACE AREA (SQ M/GM)	7.0	5.9	4.6	3.0	8.1	4.1
TVA SLURRY CHARACTERIZATION						
SLURRY SOLIDS %	8.8	7.3	11.6	7.9	15.6	8.7
SETTLED % SOLIDS	38.1	32.2	39.1	46.4	34.0	44.9
SETTLED BULK DENSITY (GM/CC)	1.32	1.22	1.35	1.45	1.24	1.30
SETTLING RATE (CM/HR)	12.4	11.5	8.7	13.9	2.4	38.4
TVA CRYSTALLOGRAPHIC ANALYSES						
SULFITE REFRACTIVE INDEX	1.592	1.581	1.584	1.590	1.593	1.590
SULFITE A AXIS	9.743	9.750	9.759	9.799	9.769	9.776
STD. ERROR	0.010	0.012	0.019	0.035	0.003	0.006
SULFITE B AXIS	10.630	10.632	10.619	10.665	10.729	10.636
STD. ERROR	0.006	0.006	0.011	0.019	0.004	0.006
SULFITE C AXIS	6.502	6.495	6.493	6.498	6.510	6.531
STD. ERROR	0.005	0.005	0.010	0.018	0.004	0.005
SCRUBBER OPERATIONAL PARAMETERS						
% SOLID OXIDATION	0.0	18.00	14.80	0.0	19.30	21.00
SAT. RATIO (RADIAN SO C.)	0.98	0.71	0.0	1.17	0.0	1.03
STOIC. RATIO	0.0	1.13	1.09	0.0	0.0	1.08
SLURRY PH	7.90	7.70	8.80	0.0	0.0	7.95
SLURRY TEMPERATURE (C)	51.0	50.0	50.0	0.0	0.0	52.0
MAKE/PASS (MOLES/THOUS GAL)	0.0	0.0	0.0	0.0	0.0	40.6
LIQ/GAS (GAL/THOUS CFM)	0.0	0.0	0.0	0.0	0.0	90.4
WT % CL IN LIQUOR	0.33	0.31	0.0	0.43	0.0	0.31
WT % MG IN LIQUOR	0.02	0.02	0.0	0.02	0.0	0.03
HOLD TANK RES. TIME (MINS)	17.0	17.0	17.0	17.0	20.0	12.0

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TABLE 2, CONTD. VENTURI SLURRY ANALYSES

RUN NUMBER	628-1B	628-1B	628-1B	703-1A	703-1A	703-1A
ANALYSIS POINT	1816	1816	1816	1816	1816	1816
DATE	092175	092875	100575	101275	102175	102875
TIME	0700	0700	0700	0700	0700	0900
ADSORBENT	LIME	LIME	LIME	LS	LS	LS
FIGURE	2D,1F	2F,2C	2E	3B	3A	3D
ON-SITE SOLIDS ANALYSES						
ASH (WT %)	44.57	45.61	45.16	32.21	0.0	48.51
CA (WT %)	25.32	24.63	24.81	32.05	23.00	24.34
SO2 (WT %)	22.08	21.98	23.19	19.86	21.60	22.07
SO3 (WT %)	5.88	4.11	5.15	7.19	4.10	3.44
CO2 (WT %)	1.88	4.19	1.90	7.54	1.76	2.47
TVA SOLIDS CHARACTERIZATION						
ASH (WT %, ACID INSOLUBLE)	40.0	41.5	33.0	27.0	45.0	45.0
CACO3 (WT %, BY IR)	6.5	3.9	3.7	21.1	2.8	6.0
CASO3 X .5 H2O (WT %, IR)	47.6	44.8	53.1	44.8	45.0	41.0
CASO4 X 2H2O (WT %, IR)	5.8	9.8	10.2	7.1	7.2	8.0
SURFACE AREA (SQ M/GM)	4.3	5.1	4.1	3.4	2.2	1.8
TVA SLURRY CHARACTERIZATION						
SLURRY SOLIDS %	9.4	25.7	9.5	18.4	10.2	12.8
SETTLED % SOLIDS	44.3	42.1	44.5	37.0	44.7	45.5
SETTLED BULK DENSITY (GM/CC)	1.21	1.31	1.26	1.27	1.29	1.36
SETTLING RATE (CM/HR)	35.6	2.1	20.5	2.5	9.6	7.8
TVA CRYSTALLOGRAPHIC ANALYSES						
SULFITE REFRACTIVE INDEX	1.590	1.589	1.588	1.589	1.590	1.590
SULFITE A AXIS	9.775	9.764	9.778	9.798	9.769	9.799
STD. ERROR	0.006	0.010	0.003	0.005	0.006	0.006
SULFITE B AXIS	10.673	10.678	10.667	10.690	10.690	10.680
STD. ERROR	0.006	0.010	0.003	0.005	0.005	0.006
SULFITE C AXIS	6.521	6.514	6.518	6.506	6.519	6.527
STD. ERROR	0.005	0.007	0.003	0.004	0.004	0.005
SCRUBBER OPERATIONAL PARAMETERS						
% SOLID OXIDATION	17.60	13.00	15.10	22.40	13.20	11.10
SAT. RATIO (RADIAN 50 C.)	0.84	0.69	0.73	0.23	0.0	0.71
STOIC. RATIO	1.08	1.11	1.04	1.43	1.06	1.13
SLURRY PH	8.25	8.10	7.95	5.85	5.25	5.31
SLURRY TEMPERATURE (C)	53.0	50.0	52.0	54.0	50.0	51.0
MAKE/PASS (MOLES/THOUS GAL)	41.8	49.4	53.6	50.1	0.0	42.2
LIQ/GAS (GAL/THOUS CFM)	97.4	82.9	88.8	69.2	63.7	63.6
WT % CL IN LIQUOR	0.33	0.37	0.44	0.49	0.0	0.67
WT % MG IN LIQUOR	0.03	0.02	0.03	0.05	0.0	0.07
HOLD TANK RES. TIME (MINS)	12.0	12.0	12.0	20.0	20.0	20.0

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TABLE 2. CONTD. VENTURI SLURRY ANALYSES

RUN NUMBER	704-1A	705-1A	706-1A	708-1A	709-1A	710-1A
ANALYSIS POINT	1816	1816	1816	1816	1816	1816
DATE	110675	111375	111975	112775	120775	121475
TIME	0700	0700	0700	0700	0700	0700
ADSORBENT	LS	LS	LS	LS	LS	LS
FIGURE	3C	1B	3E,3F	-	1A	-
ON-SITE SOLIDS ANALYSES						
ASH (WT %)	34.64	41.69	47.87	34.16	42.87	39.70
CA (WT %)	33.49	27.42	23.99	29.27	26.88	28.54
SO ₂ (WT %)	20.95	23.80	23.25	20.17	20.56	20.43
SO ₃ (WT %)	2.64	1.59	4.12	6.31	4.66	3.72
CO ₂ (WT %)	9.31	7.47	1.47	6.84	5.12	8.09
TVA SOLIDS CHARACTERIZATION						
ASH (WT %, ACID INSOLUBLE)	27.0	35.0	40.0	27.0	30.0	32.0
CACD ₃ (WT %, BY IR)	30.9	16.4	2.0	11.1	13.4	22.4
CASO ₃ X .5 H ₂ O (WT %, IR)	34.8	40.1	48.1	54.1	47.5	39.5
CASO ₄ X 2H ₂ O (WT %, IR)	7.3	8.4	10.0	7.8	9.1	6.1
SURFACE AREA (SQ M/GM)	2.5	1.8	2.2	2.2	2.5	2.3
TVA SLURRY CHARACTERIZATION						
SLURRY SOLIDS %	16.4	14.5	12.6	14.4	15.2	16.4
SETTLED % SOLIDS	42.2	50.3	40.6	44.6	43.5	43.5
SETTLED BULK DENSITY (GM/CC)	1.34	1.33	1.40	1.34	1.31	1.32
SETTLING RATE (CM/HR)	4.3	9.0	8.5	4.5	3.6	3.9
TVA CRYSTALLOGRAPHIC ANALYSES						
SULFITE REFRACTIVE INDEX	1.591	1.591	1.592	1.590	1.592	1.595
SULFITE A AXIS	9.795	9.781	9.790	9.790	9.785	9.797
STD. ERROR	0.006	0.005	0.010	0.003	0.002	0.003
SULFITE B AXIS	10.683	10.679	10.691	10.657	10.673	10.660
STD. ERROR	0.006	0.004	0.006	0.004	0.002	0.003
SULFITE C AXIS	6.511	6.509	6.534	6.503	6.505	6.492
STD. ERROR	0.005	0.003	0.005	0.002	0.001	0.002
SCRUBBER OPERATIONAL PARAMETERS						
% SOLID OXIDATION	9.20	5.10	12.40	21.30	15.30	12.73
SAT. RATIO (RADIAN 50 C.)	0.12	0.25	1.11	0.57	0.57	0.15
STOIC. RATIO	1.66	1.25	1.03	1.30	1.26	1.39
SLURRY PH	5.84	6.00	5.25	5.85	5.71	6.03
SLURRY TEMPERATURE (C)	52.0	52.0	50.0	51.0	51.0	55.0
MAKE/PASS (MOLES/THOUS GAL)	70.0	61.1	47.1	47.5	53.0	63.3
LIQ/GAS (GAL/THOUS CFM)	64.3	67.0	63.9	63.9	63.9	63.1
WT % CL IN LIQUOR	0.54	0.34	0.37	0.45	0.42	0.37
WT % MG IN LIQUOR	0.11	0.06	0.07	0.09	0.09	0.08
HOLD TANK RES. TIME (MINS)	20.0	20.0	12.0	12.0	12.0	12.0

NOTE: A VALUE OF "0.0" INDICATES EITHER DATA NOT AVAILABLE OR WORK IN PROGRESS

TABLE 2, CONTD. VENTURI SLURRY ANALYSES

RUN NUMBER	710-1A	711-1B	713-1A		717-1A	FACT.
ANALYSIS POINT	1816	1816	1816	1816	1816	1816
DATE	122275	010176	010976	012276	013176	021576
TIME	0700	0700	0700	0700	0730	0730
ADSORBENT	LS	LS	LS	LS	LS	LIME
FIGURE	-	9A,9D 8C	8D	-	-	4A,4B
ON-SITE SOLIDS ANALYSES						
ASH (WT %)	44.52	43.05	53.73	40.77	41.80	38.03
CA (WT %)	26.71	27.41	22.47	28.28	27.46	28.70
SO2 (WT %)	24.50	17.94	17.87	22.95	22.49	22.62
SO3 (WT %)	1.82	4.43	4.08	3.42	4.79	7.64
CO2 (WT %)	4.31	7.04	1.93	5.56	3.74	1.98
TVA SOLIDS CHARACTERIZATION						
ASH (WT %, ACID INSOLUBLE)	42.0	37.0	43.0	35.5	39.0	34.5
CaCO3 (WT %, BY IR)	12.4	15.2	6.8	11.9	5.6	4.7
CaSO3 X .5 H2O (WT %, IR)	41.5	39.1	41.9	44.7	50.3	53.8
CaSO4 X 2H2O (WT %, IR)	9.1	8.7	8.3	7.9	5.1	7.0
SURFACE AREA (SQ M/GM)	1.9	3.1	2.9	3.1	2.3	5.2
TVA SLURRY CHARACTERIZATION						
SLURRY SOLIDS %	16.3	16.0	15.0	17.2	15.9	17.2
SETTLED % SOLIDS	43.2	40.8	41.8	41.6	42.7	50.9
SETTLED BULK DENSITY (GM/CC)	1.34	1.29	1.30	1.30	1.30	1.29
SETTLING RATE (CM/HR)	4.6	3.4	4.8	2.8	3.6	6.3
TVA CRYSTALLOGRAPHIC ANALYSES						
SULFITE REFRACTIVE INDEX	1.594	1.591	1.590	1.591	1.591	1.590
SULFITE A AXIS	9.786	9.800	9.791	9.795	9.806	9.786
STD. ERROR	0.002	0.004	0.002	0.003	0.003	0.003
SULFITE E AXIS	10.667	10.665	10.673	10.660	10.665	10.653
STD. ERROR	0.003	0.004	0.002	0.004	0.003	0.003
SULFITE C AXIS	6.501	6.515	6.519	6.517	6.511	6.450
STD. ERROR	0.002	0.002	0.001	0.002	0.002	0.002
SCRUBBER OPERATIONAL PARAMETERS						
% SOLID OXIDATION	5.62	16.50	15.40	10.60	14.50	21.30
SAT. RATIO (RADIAN 50 C.)	0.23	0.90	1.17	1.11	0.64	0.54
STOIC. RATIO	1.18	3.46	1.21	1.26	1.19	1.14
SLURRY PH	5.83	5.57	5.14	5.50	5.53	7.93
SLURRY TEMPERATURE (C)	52.0	52.0	48.0	50.0	50.0	50.0
MAKE/PASS (MOLES/THOUS GAL)	63.9	58.3	49.6	52.5	53.8	41.0
LIQ/GAS (GAL/THOUS CFM)	64.1	63.7	64.2	65.6	64.1	85.0
WT % CL IN LIQUOR	0.37	0.56	0.55	0.44	0.34	0.49
WT % HG IN LIQUOR	0.09	0.07	0.08	0.48	0.43	0.05
HOLD TANK RES. TIME (MINS)	12.0	6.0	6.0	6.0	6.0	12.0

NOTE: A VALUE OF "0.0" INDICATES EITHER DATA NOT AVAILABLE OR WORK IN PROGRESS

TABLE 2, CONTD. VENTURI SLURRY ANALYSES

RUN NUMBER	FACT.	FACT.	FACT.	FACT.	FACT	FACT
ANALYSIS POINT	1816	1816	1816	1816	1816	1816
DATE	022176	030276	030676	031476	032076	040376
TIME	0730	0730	0730	0730	0730	0730
ADSORBENT	LIME	LIME	LS	LS	LS	LS
FIGURE	4C,4D	4E,4F	-	5B	5A,5D	5C
ON-SITE SOLIDS ANALYSES						
ASH (WT %)	58.75	64.01	45.48	42.39	43.98	36.10
CA (WT %)	19.16	20.36	27.58	28.08	26.08	29.13
SO ₂ (WT %)	13.71	16.45	19.19	16.84	18.76	17.42
SO ₃ (WT %)	6.04	2.56	2.95	5.58	6.36	6.83
CO ₂ (WT %)	1.16	1.17	5.37	6.64	4.24	5.31
TVA SOLIDS CHARACTERIZATION						
ASH (WT %, ACID INSOLUBLE)	61.0	45.0	33.0	30.0	35.0	38.0
CaCO ₃ (WT %, BY IR)	5.3	3.0	13.0	19.0	31.0	10.0
CaSO ₃ X .5 H ₂ O (WT %, IR)	27.7	40.0	43.0	39.0	22.0	42.0
CaSO ₄ X 2H ₂ O (WT %, IR)	6.0	13.0	11.0	12.0	12.0	10.0
SURFACE AREA (SQ M/GM)	5.0	5.0	5.3	3.5	3.3	3.1
TVA SLURRY CHARACTERIZATION						
SLURRY SOLIDS %	16.6	16.1	15.5	16.7	15.3	18.7
SETTLED % SOLIDS	55.6	48.9	44.4	45.4	60.6	69.1
SETTLED BULK DENSITY (GM/CC)	1.37	1.35	1.35	1.33	1.33	1.36
SETTLING RATE (CM/HR)	8.7	5.8	4.1	4.4	3.4	3.3
TVA CRYSTALLOGRAPHIC ANALYSES						
SULFITE REFRACTIVE INDEX	1.586	1.585	1.585	1.588	1.590	1.587
SULFITE A AXIS	9.774	9.773	9.790	9.786	9.797	9.798
STD. ERROR	0.004	0.004	0.004	0.002	0.004	0.003
SULFITE B AXIS	10.652	10.650	10.665	10.654	10.674	10.656
STD. ERROR	0.004	0.004	0.004	0.002	0.004	0.003
SULFITE C AXIS	6.501	6.511	6.492	6.515	6.496	6.523
STD. ERROR	0.002	0.002	0.002	0.002	0.002	0.002
SCRUBBER OPERATIONAL PARAMETERS						
% SOLID OXIDATION	26.10	11.10	10.10	20.95	21.30	23.90
SAT. RATIO (RADIAN 50 C.)	1.22	1.19	1.33	1.21	1.23	1.03
STOIC. RATIO	1.18	1.23	1.46	1.51	1.25	1.43
SLURRY PH	8.13	8.18	5.78	5.79	6.73	5.46
SLURRY TEMPERATURE (C)	51.0	50.0	51.0	50.0	0.0	53.0
MAKE/PASS (MOLES/THOUS GAL)	33.2	68.6	79.4	66.4	53.0	56.9
LIG/GAS (GAL/THOUS CFM)	43.6	5.3	44.2	33.1	30.0	46.7
WT % CL IN LIQUOR	0.88	1.22	1.36	1.30	0.0	1.67
WT % MG IN LIQUOR	0.04	0.06	0.06	0.05	0.0	1.02
HOLD TANK RES. TIME (MINS)	0.0	6.0	12.0	6.0	4.5	9.5

NOTE: A VALUE OF "0.0" INDICATES EITHER DATA NOT AVAILABLE OR WORK IN PROGRESS

TABLE 2, CONTD. VENTURI SLURRY ANALYSES

RUN NUMBER	FACT	FACT	629-1A	629-1A	630-1A	631-1A
ANALYSIS POINT	1816	1816	1816	1816	1816	1816
DATE	041476	042176	050176	050876	051576	052176
TIME	0730	0730	0730	0730	0730	0730
ABSORBENT	LS	LS	LIME	LIME	LIME	LIME
FIGURE	—	5E5F	—	6B	6A	—
ON-SITE SOLIDS ANALYSES						
ASH (WT %)	35.44	38.06	34.90	37.41	46.40	38.83
CA (WT %)	30.65	29.98	28.11	28.34	24.25	27.60
SO ₂ (WT %)	24.44	19.36	25.91	26.54	22.38	26.78
SO ₃ (WT %)	4.88	5.43	9.64	7.39	6.27	6.59
CO ₂ (WT %)	7.93	7.09	0.19	0.19	0.55	0.44
TVA SOLIDS CHARACTERIZATION						
ASH (WT %, ACID INSOLUBLE)	20.0	30.0	30.0	35.0	30.0	35.0
CACD ₃ (WT %, BY IR)	16.0	14.0	0.0	1.0	0.0	1.0
CASO ₃ X .5 H ₂ O (WT %, IR)	56.0	44.0	9.0	57.0	70.0	58.0
CASO ₄ X 2H ₂ O (WT %, IR)	8.0	12.0	1.0	7.0	0.0	6.0
SURFACE AREA (SQ M/GM)	4.8	3.5	7.6	5.0	3.8	5.4
TVA SLURRY CHARACTERIZATION						
SLURRY SOLIDS %	20.7	16.5	10.0	8.6	9.5	9.6
SETTLED % SOLIDS	27.9	58.3	43.2	50.3	46.7	46.7
SETTLED BULK DENSITY (GM/CC)	1.21	1.35	1.35	1.34	1.31	1.31
SETTLING RATE (CM/HR)	2.6	3.0	10.0	17.3	14.3	19.3
TVA CRYSTALLOGRAPHIC ANALYSES						
SULFITE REFRACTIVE INDEX	1.589	1.592	1.585	1.586	1.591	1.592
SULFITE A AXIS	9.797	9.796	9.793	9.786	9.797	9.794
STD. ERROR	0.003	0.003	0.003	0.003	0.003	0.003
SULFITE B AXIS	10.648	10.658	10.675	10.663	10.669	10.659
STD. ERROR	0.003	0.003	0.003	0.003	0.003	0.003
SULFITE C AXIS	6.498	6.513	6.515	6.511	6.504	6.497
STD. ERROR	0.002	0.002	0.002	0.002	0.002	0.002
SCRUBBER OPERATIONAL PARAMETERS						
% SOLID OXIDATION	13.70	18.30	22.90	13.20	18.30	16.40
SAT. RATIO (RADIAN 50 C.)	0.51	1.10	0.45	0.46	0.25	0.09
STOIC. RATIO	1.23	1.44	0.95	0.99	1.01	0.98
SLURRY PH	5.39	5.70	6.04	6.04	6.17	6.95
SLURRY TEMPERATURE (C)	50.0	52.0	54.0	50.0	51.0	50.0
MAKE/PASS (MOLES/THOUS GAL)	74.2	98.4	59.7	59.1	56.3	81.2
LIQ/GAS (GAL/THOUS CFM)	61.7	23.4	63.9	64.2	63.7	43.6
WT % CL IN LIQUOR	0.91	0.45	0.34	0.35	0.55	0.57
WT % MG IN LIQUOR	1.24	0.77	0.45	0.33	0.41	0.45
HOLD TANK RES. TIME (MINS)	9.5	0.0	3.0	3.0	3.0	3.0

NOTE: A VALUE OF "0.0" INDICATES EITHER DATA NOT AVAILABLE OR WORK IN PROGRESS

TABLE 2. CONTD. VENTURE SLURRY ANALYSES

RUN NUMBER	632-1A	633-1A	634-1A	634-1A
ANALYSIS POINT	1816	1816	1816	1816
DATE	053176	060976	062076	062776
TIME	0730	0730	0730	0730
ADSORBENT	LIME	LIME	LIME	LIME
FIGURE	6D	6C	6F	6E
ON-SITE SOLIDS ANALYSES				
ASH (WT %)	51.50	42.96	25.89	10.90
CA (WT %)	23.54	28.38	34.19	40.97
SO2 (WT %)	22.44	23.98	28.77	34.54
SO3 (WT %)	3.26	5.88	6.32	10.23
CO2 (WT %)	0.49	1.06	5.33	2.82
TVA SOLIDS CHARACTERIZATION				
ASH (WT %, ACID INSOLUBLE)	40.0	30.0	2.0	1.0
CACD3 (WT %, BY IR)	2.0	2.0	20.0	8.0
CASD3 X .5 H2O (WT %, IR)	51.0	58.0	58.0	80.0
CASD4 X 2H2O (WT %, IR)	6.0	10.0	20.0	12.0
SURFACE AREA (SQ M/GM)	4.5	5.8	5.9	7.1
TVA SLURRY CHARACTERIZATION				
SLURRY SOLIDS %	8.4	8.7	5.8	4.5
SETTLED % SOLIDS	44.2	39.7	55.7	40.6
SETTLED BULK DENSITY (GM/CC)	1.29	1.29	1.46	1.21
SETTLING RATE (CM/HR)	19.6	13.8	100.2	90.0
TVA CRYSTALLOGRAPHIC ANALYSES				
SULFITE REFRACTIVE INDEX	1.588	1.591	1.594	1.595
SULFITE A AXIS	9.795	9.791	9.795	9.764
STD. ERROR	0.004	0.003	0.004	0.002
SULFITE B AXIS	10.681	10.669	10.615	10.656
STD. ERROR	0.004	0.003	0.004	0.002
SULFITE C AXIS	6.497	6.500	6.488	6.508
STD. ERROR	0.002	0.002	0.002	0.001
SCRUBBER OPERATIONAL PARAMETERS				
% SOLID OXIDATION	10.40	16.40	14.90	19.10
SAT. RATIO (RADIAN 50 C.)	0.17	0.14	1.40	1.19
STOIC. RATIO	1.07	1.05	1.15	1.09
SLURRY PH	7.04	7.08	8.12	7.94
SLURRY TEMPERATURE (C)	50.0	50.0	52.0	53.0
MAKE/PASS (MOLES/THOUS GAL)	51.4	55.6	29.0	39.8
LIQ/GAS (GAL/THOUS CFM)	44.7	62.8	63.5	64.0
WT % CL IN LIQUOR	0.71	0.50	2.13	0.37
WT % MG IN LIQUOR	0.48	0.44	0.03	0.06
HOLD TANK RES. TIME (MINS)	3.0	3.0	12.0	12.0

NOTE: A VALUE OF "0.0" INDICATES EITHER DATA NOT AVAILABLE OR WORK IN PROGRESS

TABLE 5

Settling Rate Determinations

Sample ID			Muscle Shoals		Shawnee	
			% solids	S.R. (cm/hr)	% solids	S.R. (cm/hr)
1816	7-18-75	0900	NA	37.9	8.9	52.5
1816	7-24-75	1230	8.5	34.2	8.6	47.5
1816	8-4-75	0700	7.8	46.0	7.5	46.9
1816	8-18-75	1000	11.7	5.4	NA	5.5
1816	9-2-75	0800	8.7	34.5	9.2	32.0
1816	9-16-75	0700	8.1	42.0	NA	NA
1816	9-30-75	0700	9.1	19.0	8.7	17.6
1816	10-15-75	0700	15.6	4.4	15.4	4.0
1816	11-4-75	0700	13.3	9.6	15.5	13.1
1816	11-13-75	0700	14.1	8.8	14.7	9.3
1816	11-19-75	1400	15.6	9.2	14.9	11.2
1816	12-8-75	1500	15.7	4.4	NA	NA
1816	12-17-75	0700	16.7	4.1	16.1	4.1
1816	12-30-75	0700	14.8	4.4	NA	4.3
1816	5-4-76	0730	12.0	5.9	NA	6.7
1816	5-17-76	1530	8.8	16.4	NA	22.0
1816	6-21-76	1530	4.1	107.1	NA	160.0
2816	8-1-75	0700	14.5	5.8	14.1	5.7
2816	8-10-75	0715	15.6	7.8	NA	NA
2816	8-26-75	0725	14.4	4.5	NA	5.5
2816	9-8-75	1425	15.0	4.8	NA	NA
2816	10-8-75	0700	14.8	5.5	14.3	5.6
2816	10-21-75	0700	15.5	4.3	NA	NA
2816	11-26-75	0700	14.2	9.1	13.8	10.1
2816	12-3-75	1500	15.7	6.2	15.6	5.4
2816	12-23-75	0700	15.7	6.4	NA	NA
2816	1-7-76	0700	15.0	7.0	14.4	7.0
2816	1-19-76	0700	15.3	6.8	14.6	7.0
2816	4-27-76	0800	17.2	2.7	NA	2.7
2816	5-12-76	0845	27.3	1.2	NA	1.7
2816	5-24-76	0730	15.6	3.9	NA	4.4
2816	6-2-76	0800	13.5	2.0	NA	3.5

Table 4
Shawnee Schedule
Venturi / Spray Tower and TCA Systems

Test Program Functions	1975							1976							
	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
1. LIMESTONE ADVANCED TESTING WITH TCA SYSTEM															
Mist Eliminator Testing															
Magnesium Oxide Addition Testing															
Alkali Utilization Testing without MgO Addition															
Factorial Testing without MgO Addition															
Factorial Testing with MgO Addition															
2. LIME ADVANCED TESTING WITH TCA SYSTEM															
Factorial Testing															
3. LIME ADVANCED TESTING WITH VENTURI/SPRAY TOWER SYSTEM															
Mist Eliminator Testing															
Variable Load Testing															
Factorial Testing (a)															
Fly Ash Free Testing															
4. LIMESTONE ADVANCED TESTING WITH VENTURI/SPRAY TOWER SYSTEM															
Mist Eliminator Testing															
Alkali Utilization Testing with and without MgO Addition															
Magnesium Oxide Addition Testing															
Factorial Testing without MgO Addition															
Factorial Testing with MgO Addition															

(a) Includes "maximizing SO₂ removal efficiency" testing (may include addition of MgO).